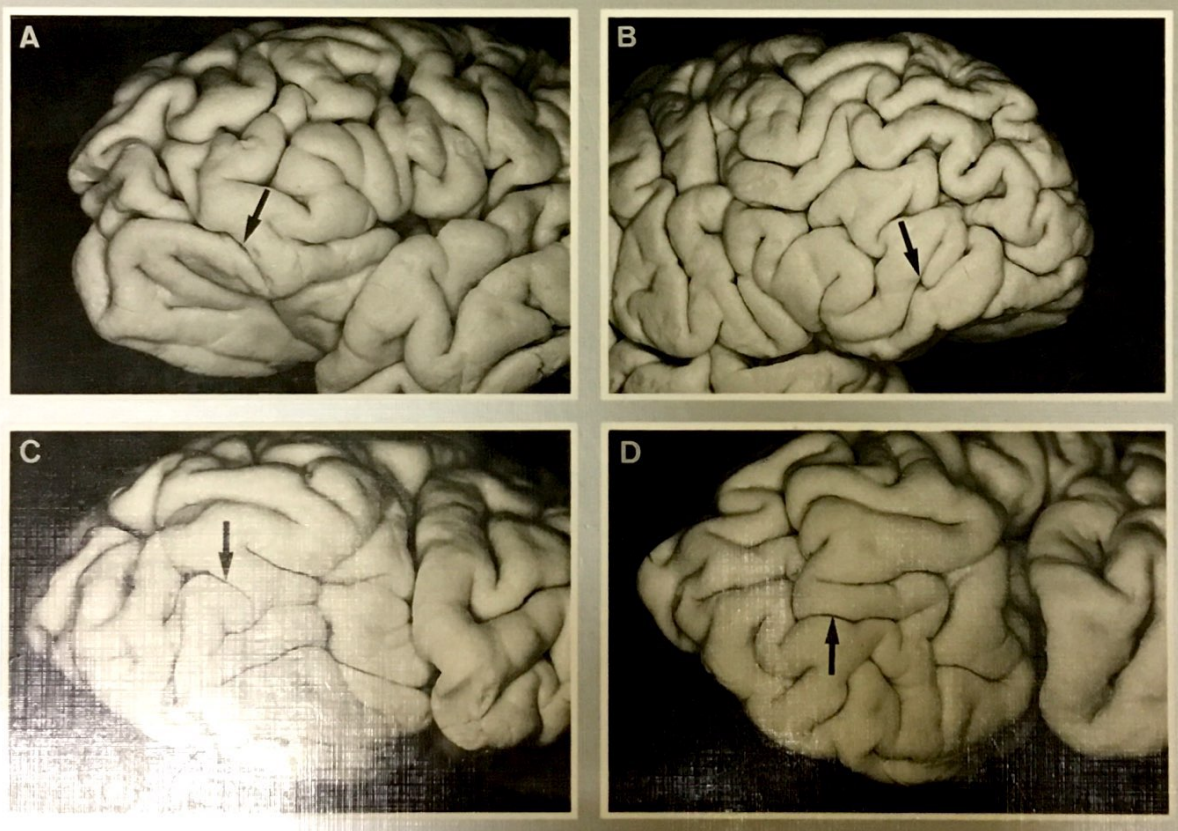
Atlas of the Cerebral Sulci

Michio Ono, Stefan Kubik and Chad D. Abernathey

Foreword by M. G. Yaşargil



Georg Thieme Verlag
Stuttgart · New York

Thieme Medical Publishers, Inc.
New York

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Michio Ono
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University of Zürich

186 Figures in 1153 Illustrations

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Library of Congress Cataloging-in-Publication Data

Ono, Michio, M.D.
Atlas of the cerebral sulci / Michio Ono, Stefan Kubik, Chad D. Abernathy ; foreword by M.G. Yaşargil.
p. cm.
Includes bibliographical references.
ISBN 0-86577-362-9 (Thieme Medical Publishers)
1. Cerebral sulci--Anatomy--Atlases.
I. Kubik, Stefan.
II. Abernathey, Chad D. III. Title.
[DNLM: 1. Cerebral Cortex--anatomy & histology--atlases. WL 17
A8855]
QM455.Q48 1989
611'.81--dc20
DNLM/DLC

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© 1990 Georg Thieme Verlag, Rüdigerstraße 14, D-7000 Stuttgart 30, Germany. Thieme Medical Publishers, Inc., 381 Park Avenue South, New York, N.Y.10016 Printed in Germany

Typesetting: R. Hurler GmbH, D-7311 Notzingen; typeset on Linotronic 300

Printing: K. Grammlich, D-7401 Pliezhausen.

ISBN 3-13-732101-8 (Georg Thieme Verlag, Stuttgart)
ISBN 0-86577-362-9 (Thieme Medical Publishers, Inc., New York)

1 2 3 4 5 6

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Foreword

From the neurosurgeon's viewpoint, a complete and in-depth understanding of the brain's subarachnoid system is essential for performing microsurgical procedures. Traditionally, the cisternal, fissural, and sulcal anatomies have been poorly studied by clinicians, and largely ignored by anatomists. However, as surgical techniques become increasingly precise, our knowledge of microanatomy must improve. The success of microsurgical techniques depends upon utilizing the natural pathways provided by the subarachnoid system to gain access to pathologic structures within the brain, while preserving the integrity of healthy adjacent tissue.

Experience in the surgical treatment of intracranial aneurysms led to the development of a systematic approach traversing the basal cisterns. Concurrently, a neuroanatomic concept for accessing parenchymal lesions (i. e. arteriovenous malformations, abscesses, and neoplasms) was fostered. By considering mass lesions to exist in either convexial or central locations, one realizes that the convexial location is related to the anatomy of the sulci and fissures, while the central location is primarily aligned with the fissural anatomy. It soon becomes apparent that any point within the cranium can be reached by following the corridors of the sulci and fissures. For example, medial convexial tumors are approached via the interhemispheric fissure; insular and hippocampal neoplasms are accessed through the Sylvian fissure; parahippocampal and parasplenial lesions are explored through the transverse fissure.

As neuroimaging techniques have evolved, our ability to correctly identify and discover pathologic lesions preoperatively and intraoperatively has improved to a remarkable degree. Postoperative examinations have given neurosurgeons a means of judging the effectiveness of their work on a purely structural basis. With these advances, however, has come a burden of proof to confirm the quality of a specific operative procedure. Gone are the days of simply „attacking" a brain tumor via the most direct avenue, disregarding anatomical boundaries. Today, techniques such as lobectomy and lobulectomy are obsolete and should be discarded in favor of specific and precise „tumorectomies". Technological advances demand that intracranial targets be approached with a malleable, flexible attitude.

Thus, a text devoted to the anatomy of the cortical sulci is warranted as a first step toward describing and categorizing the highly varied structural patterns of the cortical surface. It is not only the neurosurgeon who can benefit from a detailed description of sulcal anatomy, but also the neuroanatomist, neuropathologist, neurobiologist, neurologist, neuroradiologist, and neurophysiologist. Great strides are being made in each of these fields regarding the pathophysiologic, neurochemical, microhistologic, and behavioral changes that occur in the normal and abnormal cerebral states.

M.G. Yaşargil, M.D.
Zürich, Switzerland

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Preface

An atlas devoted exclusively to the anatomical descriptions and relationships of the cortical sulci has not previously been published. Ostensibly, it would seem an insurmountable task to classify the myriad sulcal patterns that exist upon the cortical surface. However, basic recurring themes can be identified in general terms, and trends in individual variabilities can be categorized. Dr. Michio Ono labored for nearly two years under the guidance of Professor Stefan Kubik, and with the help of Dr. B. Szarvas at the University of Zürich's Institute of Anatomy. His goal was to construct a standardized template of sulcal anatomy. In this he has been largely successful.

My responsibility has been to compile the text in a format useful to the clinician as well as to the anatomist. The techniques of microsurgery, pioneered by Professor M. Gazi Yaşargil, require a thorough and erudite understanding of sulcal, fissural, and cisternal anatomy for the performance of increasingly precise neurosurgical operations. Hopefully, this text will provide the practicing physician with an additional means of assessing his or her operative approaches and techniques.

Section 1 is concerned primarily with defining and identifying the anatomical characteristics of the sulci. Sections 2, 3, and 4 deal with the potential sulcal patterns observed. Section 5 details Sylvian fissure anatomy. Actual measurements of the sulci are given in Section 6. Coronal, horizontal, and sagittal sections of the brain are shown in Section 7. Of particular interest to the neurosurgeon are the chapters on sulcal depth and the proximity of the sulci to the extensions of the lateral ventricles' extensions. Section 8 is devoted to simple observations of the inner topography of the sulci when opened in a surgical fashion. Finally, Section 9 briefly displays the arterial vasculature traversing the sulci.

As with any topic related to the human nervous system, a multidisciplinary perspective must be applied to the investigation of the cortical sulci. The surgeon must see with the eyes of an anatomist to appreciate the subtleties of the subarachnoid system, just as the anatomist must have the insight of a surgeon when considering the complexities of living tissue. It is our intent that this book represent an initial step toward achieving a cohesive interpretation of the cortical sulci specifically, and of their contribution to cerebral anatomy in general.

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Acknowledgements

The authors wish to express their sincere gratitude to Professor M.G. Yaşargil, Chairman of the Department of Neurosurgery at the University of Zürich, for his insightful supervision and kindly assistance in the preparation of this text.

Special mention is extended to Mr. A. Lang, who has developed a new and innovative method of preparing rubberized brain models. These models were used extensively for displaying the surgical opening of the sulci in Section 8.

Appreciation is due Dr. B. Szarvas for prolonged assistance during the dissection and data-gathering phase of the project.

The authors are indebted to Mr. Peter Roth, a talented illustrator and artist, for his invaluable advice and selected artwork.

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1

Introduction

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Chapter 1
Background

The sulcal patterns of twenty-five autopsy specimen brains were examined for variations and consistencies in location, shape, size, dimensions, and relationships to parenchymal structures. Data concerning the age and sex of the specimens were not available. The brains were fixed by immersion in 4% formaldehyde solution. For preparation, the brain stem was sectioned at the mesencephalic level and the two hemispheres separated by a midline sagittal section. Only hemispheres which did not show visible pathology or postmortem artifactual deformities were utilized. After careful removal of the pia mater and cerebral vasculature, the pattern of each sulcus was dissected, measured, sketched, and photographed.

To take into account the shape-dependent length of the sulci, their length was determined by means of a cord running along the gutter of the sulci. The relationships of the sulci to the internal structures (i.e. nuclei and ventricular system), and the measurements of distances between the floor of the sulci and the ventricles, were examined on coronal sections (5 brains), horizontal sections (2 brains), and sagittal sections (1 brain).

Rigid, formalin-fixed brains are not suitable for demonstrating the inner structure of the sulci. Molded silicon brain models were therefore used for this purpose. Such duplicates show the exact sulcal pattern, while their elasticity allows the furrows to be opened without destroying the original form.

Figure 1.1 **Relationship of the brain surfaces to the cranial vault**
The brain is enclosed and protected by the skull, alternatively named the neurocranium or calvarium. Two projections of the dura mater, the falx cerebri and the tentorium cerebelli, divide the intracranial cavity into three compartments (Fig. 1.1C). The posterior cranial fossa constitutes the posteroinferior compartment and contains the cerebellum and the inferior portion of the brain stem. It is separated from the paired hemispheric compartments by the tentorium cerebelli (Fig. 1.1C). The boundaries of the hemispheric compartments are formed by the skull cap (calva) superiorly and laterally, the falx cerebri medially, the anterior and middle cranial fossa, and the tentorium cerebelli inferiorly (Fig. 1.1A–C). The hemispheric compartments show a triangular form in coronal section. The cerebral hemispheres have three surfaces corresponding to the compartments' form: a convex lateral surface, a flattened medial surface, and a two-stage basal surface (Fig. 1.2A). The anterior portion of the basal surface is formed by the orbital surface of the frontal lobe (Fig. 1.1A), and the posterior portion by the inferior surfaces of the temporal and occipital lobes (Fig. 1.2A).

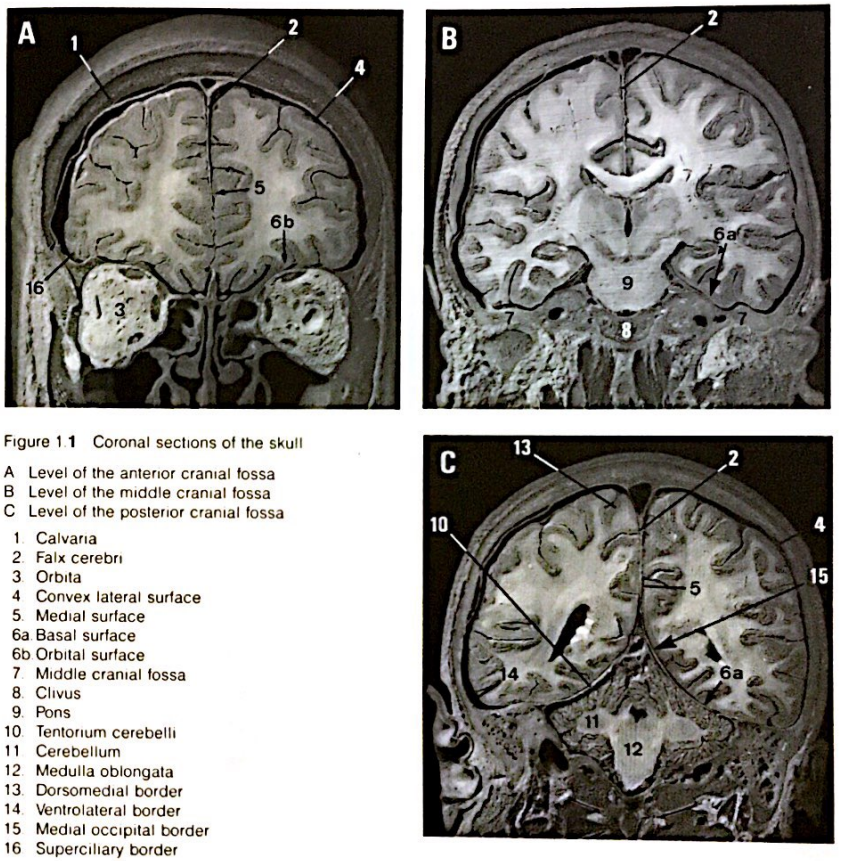

Figure 1.1 Coronal sections of the skull

A Level of the anterior cranial fossa
B Level of the middle cranial fossa
C Level of the posterior cranial fossa

1. Calvaria
2. Falx cerebri
3. Orbita
4. Convex lateral surface
5. Medial surface
6a Basal surface
6b Orbital surface
7. Middle cranial fossa
8. Clivus
9. Pons
10. Tentorium cerebelli
11. Cerebellum
12. Medulla oblongata
13. Dorsomedial border
14. Ventrolateral border
15. Medial occipital border
16. Supercilliary border

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Figure 1.2 Borders of the cerebral hemispheres

Each hemisphere presents five more or less well-defined borders, which delimit its several surfaces:

1. The dorsomedial border (German: *Mantelkante*) is the curved upper boundary of the hemisphere. It extends from the frontal to the occipital pole and separates the convexity from the medial surface (Fig. 1.1A–C).

2. The superciliary border separates the lateral surface of the frontal lobe from its orbital surface. It extends from the frontal pole to the beginning of the Sylvian fissure (Fig. 1.2A,C).

3. The ventrolateral border follows the outline of the base of the brain on its lateral aspect, extending from the temporal to the occipital pole. It separates the lateral surfaces of the temporal and occipital lobes from their basal surfaces. The downward convex anterior portion of the bordering line corresponds to the contact between the temporal lobe and the middle cranial fossa; the posterior upward convex portion marks the contact between the occipital lobe and the tentorium cerebelli (Fig. 1.2A).

4. The medial orbital border separates the medial surface of the frontal lobe from its orbital surface. It is the basal continuation of the dorsomedial border, forming a straight line between the frontal pole and the lamina terminalis (Fig. 1.2C).

5. The medial occipital border can only be seen when the caudal part of the brain stem and the cerebellum are removed. As a coronal section shows, this somewhat rounded border lies in the angle between the falx cerebri and the tentorium cerebelli, vaguely separating the medial surface of the occipital lobe from its obliquely situated basal surface (Fig. 1.1C). This border lies caudal to the calcarine sulcus and extends from the occipital pole to a region just below the splenium of the corpus callosum (Fig. 1.2B,C, dotted line).

Figure 1.2 ▷

A Brain in situ – lateral aspect (left hemisphere)
B Brain in situ – medial aspect (left hemisphere)
C Medial and inferior aspects of right hemisphere

1. Dorsomedial border
2. Superciliary border
3. Ventrolateral border
4. Temporo-occipital notch
5. Middle cranial fossa
6. Tentorium cerebelli
7. Cerebellum
8. Falx cerebri
9. Medial surface
10. Tentorium
11. Calcarine sulcus
12. Medial occipital border
13. Parahippocampal gyrus
14. Posterior cranial fossa
15. Medial orbital border
16. Orbital surface
17. Basal surface
18. Frontal pole
19. Temporal pole
20. Occipital pole

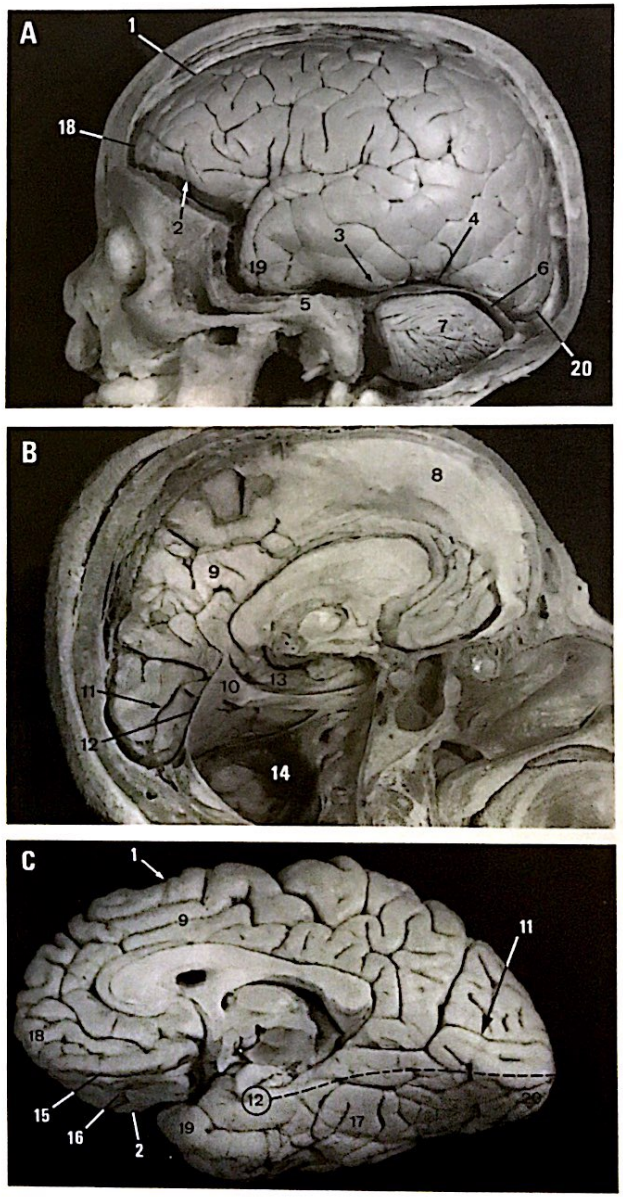

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Figure 1.3 Development of the sulci
During the initial phase of brain development (between the eighth and tenth weeks), so-called transitory furrows appear. They achieve their maximal development in the third to fourth months. As their number, expansion, and shape are highly variable, they cannot be divided into specific groups. They disappear completely, and are therefore not precursors of the definitive furrows. In the fifth month, the surface of the hemispheres becomes smooth. Only the insular area shows a pit-like depression. During the sixth to seventh months of fetal life, the first definitive furrows (central, parieto-occipital, and calcarine sulci) begin to appear. These are soon followed by further secondary and tertiary furrows. Some of these develop after birth, complicating the basic pattern. From an anatomist's viewpoint, only the main furrows can be categorized in a general fashion.

The reason for the variability of the sulcal pattern has not yet been determined. It is clear that the principal features of gyral patterns are genetically determined. The development of the sulcal pattern of the medial surface of the hemisphere seems to be influenced by the development of the corpus callosum. Congenital absence of the corpus callosum is linked to the absence of an arched cingulate gyrus and to a radial pattern of the furrows and gyri of the medial surface (compare Figs. 1.3A and 1.3B).

The course and pattern of the furrows and gyri differ not only in individuals but even between hemispheres of the same brain. The greatest variability can be seen in the frontal and parieto-occipital regions, which are especially developed in humans.

The insula is a deep-lying structure, and is overlapped by the opercula of the surrounding lobes. The broad Sylvian fossa (Fig. 1.3C) becomes a narrow space, the Sylvian fissure, due to the development of the opercula (Fig. 1.3D). The development of the Sylvian fissure and the insula is constant. These are therefore the most important identifiable structures for anatomic orientation.

To facilitate a general orientation, most texts use simplified schemes which show only the most important and constant sulci and gyri. Such depictions can be memorized more easily than realistic presentations, which cannot be generalized due to the extent of individual variability. It must be mentioned that the schemes often differ and that, especially in the temporal region, the same sulci often have different names on the convex and basal surfaces. The designation of the boundary furrow between the lateral occipitotemporal (fusiform) and the inferior temporal gyri varies most frequently in nomenclature; it is sometimes referred to as the occipitotemporal sulcus and at other times as the inferior temporal sulcus.

Although some constant furrows are important for general orientation, it must be emphasized that due to great individual variability, a scheme is often altered beyond recognition. For this reason, an investigation of the various patterns and connections of the single furrows is warranted, to facilitate the orientation on diverse preparations and the performance of surgical procedures.

Fig. 1.3

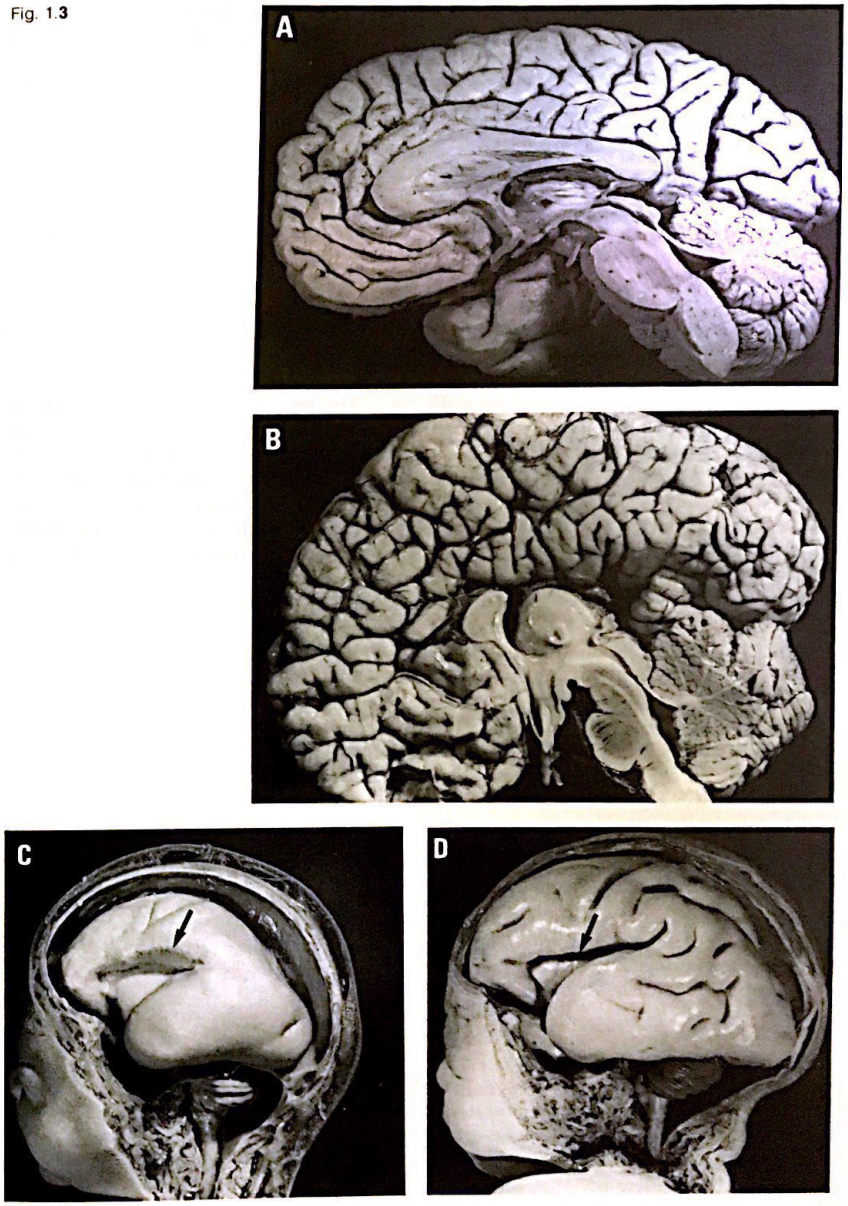

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Figure 1.4 **The lobes**

Generally, five conventional lobes are distinguished: frontal, parietal, temporal, occipital, and limbic. Additionally, many authors regard the insula as a separate lobe and name it the insular or central lobe. Some authors consider the olfactory bulb and tract, on a developmental basis, as the olfactory lobe and list it as such. It is more often described as a part of the olfactory pathway.

The two polar (frontal and occipital) lobes expand to all three hemispheric surfaces. The others, depending on their position, border only two, the convex and medial or the convex and basal surfaces. The boundaries are formed by natural structures such as the sulci, or by artificial lines. Such lines are the lateral parietotemporal and the temporo-occipital lines on the convex surface, and the basal parietotemporal line on the basal surface. The vertically running lateral parieto-temporal line connects the marginal end of the parieto-occipital sulcus with the preoccipital notch. Its continuation, the basal parieto-temporal line, connects the preoccipital notch with the inferior end of the parieto-occipital sulcus. The horizontally situated temporo-occipital line is drawn from the posterior end of the Sylvian fissure to the middle of the lateral parietotemporal line.

The frontal lobe includes approximately one-third of the entire hemispheric surface. On the lateral surface it extends from the frontal pole to the central sulcus, and is separated from the temporal lobe by the Sylvian fissure. On the medial surface it is separated from the limbic lobe (gyrus cinguli) by the sulcus cinguli, and from the parietal lobe by a line drawn from the marginal end of the central sulcus to the cingulate sulcus. Basally, the entire orbital surface belongs to the frontal lobe.

The parietal lobe is bounded on the lateral surface anteriorly by the central sulcus, posteriorly by the upper half of the parieto-temporal line, and inferiorly by the posterior end of the Sylvian fissure and the temporo-occipital line. On the medial surface, the boundaries are: the parieto-occipital sulcus, the subparietal sulcus, and a connecting line between the marginal end of the central sulcus and the cingulate sulcus.

The temporal lobe presents a lateral (convex) and a basal surface. The lateral surface is separated from the frontal and parietal lobes by the Sylvian fissure and the temporo-occipital line. It is separated from the occipital lobe by the lateral and basal parietotemporal lines, and from the limbic lobe by the collateral and rhinal sulci.

The occipital lobe lies behind the lateral parieto-occipital line on the convex surface, and behind the parieto-occipital sulcus and basal parietotemporal line on the medial and basal surfaces.

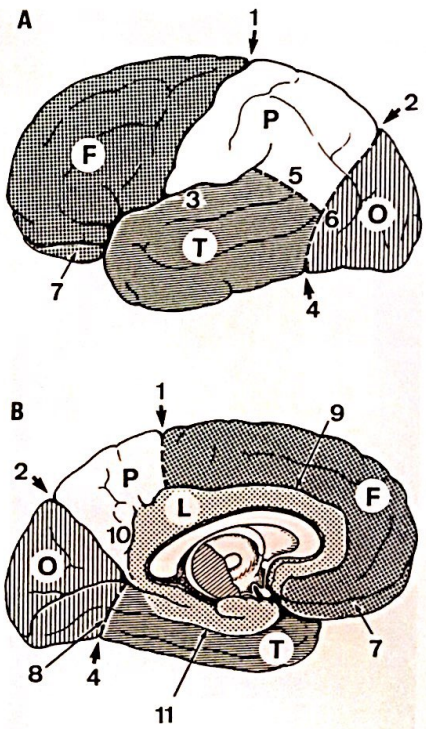
The limbic lobe includes the cingulate and parahippocampal gyri. Because of its arcuate form, it is also named the fornicate lobe. With regard to the limbic system, the limbic lobe represents the external circle, while the paraterminal gyrus, fasciolar gyrus, dentate gyrus, and indusium griseum make up the inner circle.

Figure 1.4
Boundaries of the lobes

A Lateral aspect of left cerebral hemisphere
B Mediobasal aspect of left cerebral hemisphere

F: Frontal lobe
P: Parietal lobe
T: Temporal lobe
O: Occipital lobe
L: Limbic lobe

1. Central sulcus
2. Parieto-occipital sulcus
3. Sylvian fissure
4. Preoccipital notch
5. Temporo-occipital line
6. Lateral parietotemporal line
7. Orbital surface
8. Basal parietotemporal line
9. Cingulate sulcus
10. Subparietal sulcus
11. Collateral sulcus



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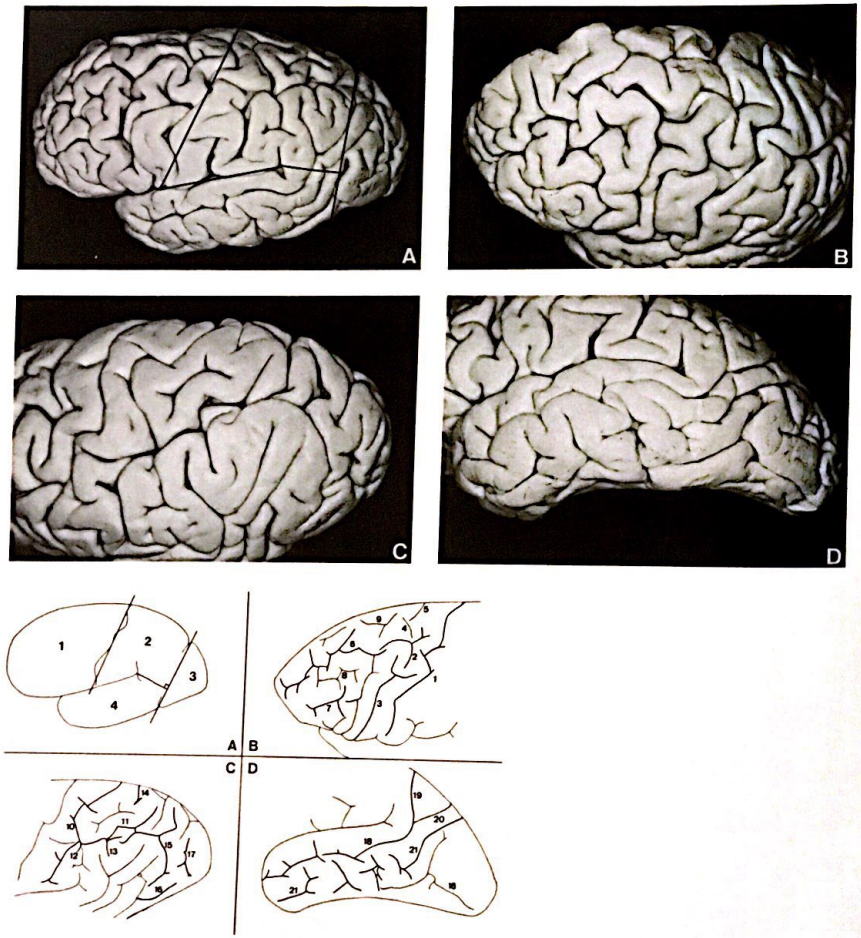
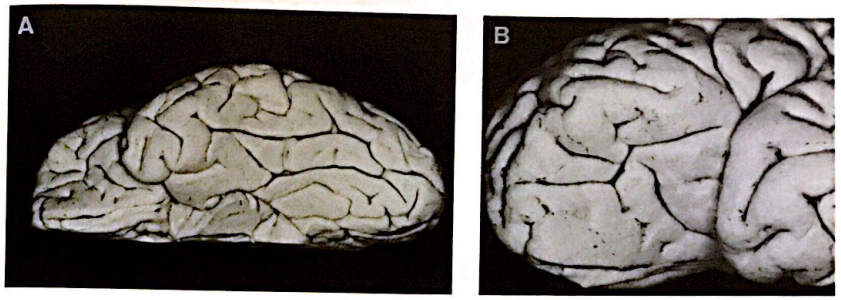
Chapter 2
Nomenclature





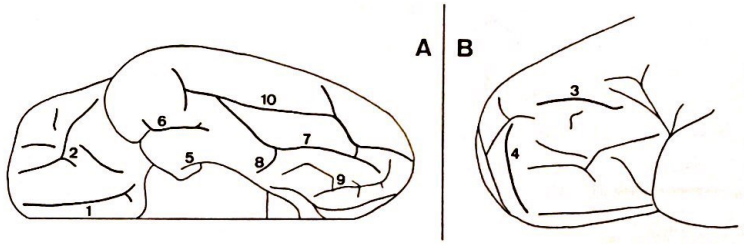


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Figure 2.2
Basal surface

I. Frontal, temporal, and occipital lobes (A)
II. Frontal lobe (B)
1. Olfactory sulcus
2. Orbital sulci
3. Fronto-orbital sulcus
4. Frontomarginal sulcus
5. Hippocampal sulcus
6. Rhinal sulcus
7. Collateral sulcus
8. Parahippocampal ramus
9. Intralingual sulcus
10. Occipitotemporal sulcus

Note: the parahippocampal ramus of the collateral sulcus is a very constant small sulcus. It usually forms a side branch of the collateral sulcus at the border between the lingual and parahippocampal gyri. The posterolateral end of this sulcus indicates the posterior end of the hippocampus in the temporal horn.

◁ Figure 2.1
Lateral surface

I. Lobe divisions (A)
1. Frontal lobe
2. Parietal lobe
3. Occipital lobe
4. Temporal lobe

II. Sulci of the frontal lobe (superofrontal view, B)
1. Central sulcus
2. Superior precentral sulcus
3. Inferior precentral sulcus
4. Marginal precentral sulcus
5. Medial precentral sulcus
6. Superior frontal sulcus
7. Inferior frontal sulcus
8. Intermediate frontal sulcus
9. Medial frontal sulcus

III. Sulci of the parietal and occipital lobes (superoccipital view, C)
10. Postcentral sulcus
11. Intraparietal sulcus
12. Primary intermediate sulcus
13. Secondary intermediate sulcus
14. Superior parietal sulcus
15. Transverse occipital sulcus
16. Lateral occipital sulcus
17. Lunate sulcus

IV. Sulci of the temporal lobe (inferolateral view, D)
18. Superior temporal sulcus
19. Angular sulcus
20. Anterior occipital sulcus
21. Inferior temporal sulcus

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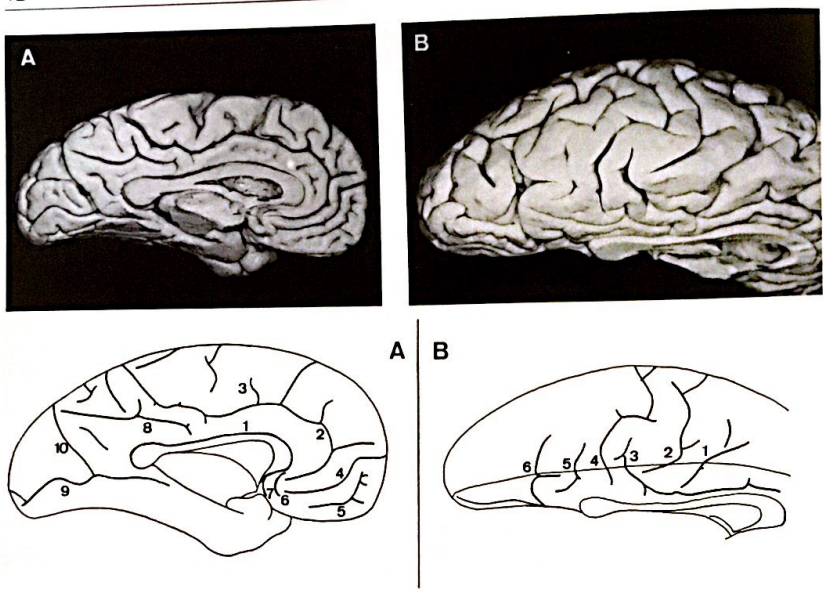


Figure 2.3
Medial surface

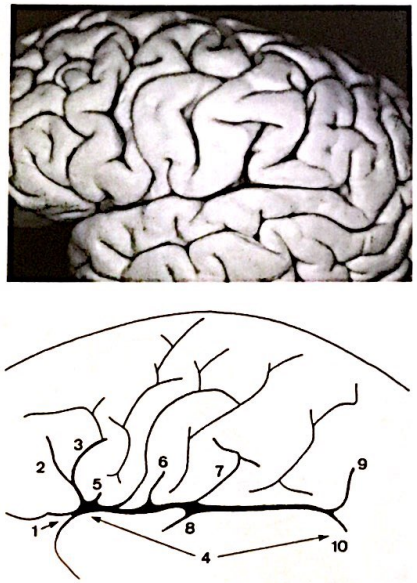
I. Sulci of the medial surface (A)
   1. Callosal sulcus
   2. Cingulate sulcus
   3. Paracentral sulcus
   4. Superior rostral sulcus
   5. Inferior rostral sulcus
   6. Anterior parolfactory sulcus
   7. Posterior parolfactory sulcus
   8. Subparietal sulcus
   9. Calcarine sulcus
   10. Parieto-occipital sulcus

II. Sulci which cross or indent the superior hemisphere margin (B)
   1. Medial precentral sulcus
   2. Central sulcus
   3. Marginal ramus of the cingulate sulcus
   4. Postcentral sulcus
   5. Superior parietal sulcus
   6. Parieto-occipital sulcus

Figure 2.4
Sylvian fissure

1. Stem of the Sylvian fissure
2. Horizontal ramus
3. Ascending ramus
4. Posterior ramus
5. Diagonal sulcus
6. Anterior subcentral sulcus
7. Posterior subcentral sulcus
8. Transverse temporal sulcus
9. Ascending terminal ramus
10. Descending terminal ramus

Note: the descending terminal ramus was identical to the transverse temporal sulcus in approximately half of all cases studied.



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Chapter 3
Classification

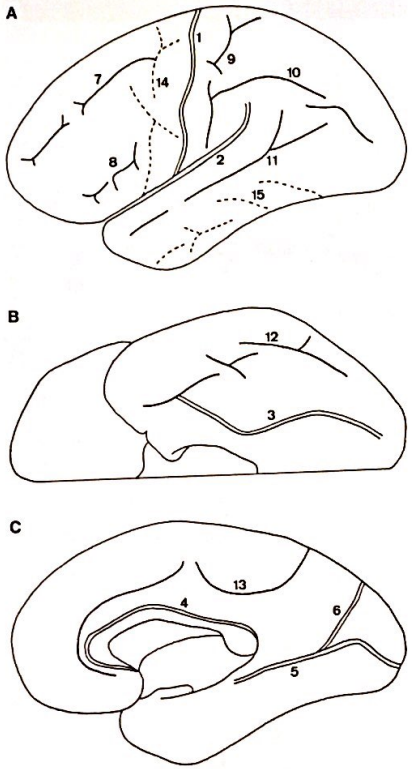


Figure 3.1

A Convex lateral surface
B Basal surface
C Medial surface

Large main sulci
(incidence rate in %)

I. Sulci with high continuous (uninterrupted) rate
1. Central sulcus – 92%
2. Sylvian fissure – 100%
3. Collateral sulcus – 100%
4. Callosal sulcus – 100%
5. Calcarine sulcus – 92%
6. Parieto-occipital sulcus – 100%

II. Sulci with low continuous (uninterrupted) rate
7. Superior frontal sulcus – 36%
8. Inferior frontal sulcus – 48%
9. Postcentral sulcus – 46%
10. Intraparietal sulcus – 50%
11. Superior temporal sulcus – 32%
12. Occipitotemporal sulcus – 36%
13. Cingulate sulcus – 58%

III. Regularly Interrupted Sulci
14. Precentral sulcus – 100%
15. Inferior temporal sulcus – 100%

Figure 3.2

A Convex lateral surface
B Basal surface
C Medial surface

Short main sulci
(incidence rate in %)

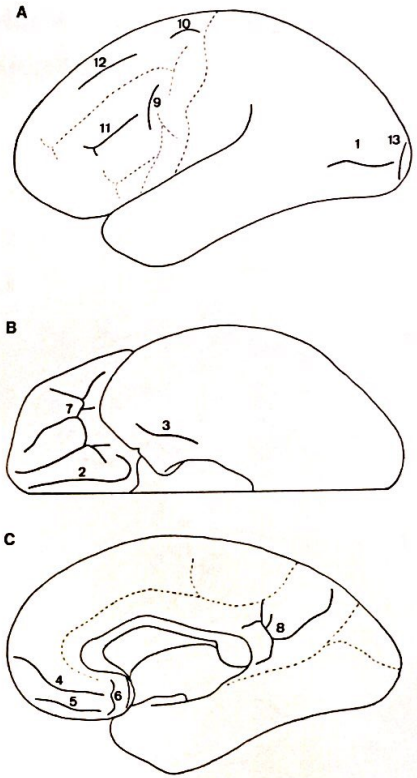
1. Lateral occipital sulcus – 96%
2. Olfactory sulcus – 100%
3. Rhinal sulcus – 100%
4. Superior rostral sulcus – 100%
5. Inferior rostral sulcus – 98%
6. Anterior parolfactory sulcus – 88%

Sulci composed of several branches
(incidence rate in %)

7. Orbital sulci – 100%
8. Subparietal sulcus – 100%

Supplementary (free) sulci
(incidence rate in %)

9. Intermediate precentral sulcus – 14%
10. Marginal precentral sulcus – 30%
11. Intermediate frontal sulcus – 86%
12. Medial frontal sulcus – 68%
13. Lunate sulcus – 62%



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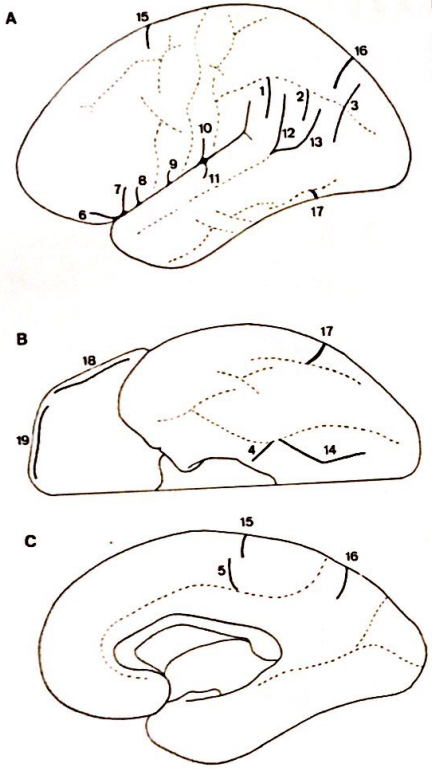

Figure 3.3

A Convex lateral surface
B Basal surface
C Medial surface

Supplementary sulci formed by a side branch of a main sulcus

I. Side branch of the intraparietal sulcus
  1. Primary intermediate sulcus
  2. Secondary intermediate solcus
  3. Transverse occipital sulcus
II. Side branch of the collateral sulcus
  4. Parahippocampal ramus
III. Side branch of the cingulate sulcus
  5. Paracentral sulcus
IV. Side branch of the Sylvian fissure
  6. Horizontal ramus
  7. Ascending ramus
  8. Diagonal sulcus
  9. Anterior subcentral sulcus
  10. Posterior subcentral sulcus
  11. Transverse temporal sulcus

Supplementary sulci formed by a terminal branch of a main sulcus

I. Posterior terminal branch of the superior temporal sulcus
  12. Angular sulcus
  13. Anterior occipital sulcus
II. Posteromedial terminal branch of the collateral sulcus
  14. Intralingual ramus

Supplementary sulci crossing the margin of the hemisphere

15. Medial precentral sulcus
16. Superior parietal sulcus
17. Sulcus of the preoccipital incisura

Supplementary sulci along the margin of the hemisphere

18. Fronto-orbital sulcus
19. Frontomarginal sulcus

Chapter 4
Types of Interruption

Figure 4.1
Types of interruption of the main sulci

I. Types of interruption (A)
  1. Pseudocontinuation (deeply interrupted)
  2. True continuation
  3. True interruption
II. Main sulci which may show all three types (B)
  1. Superior frontal sulcus
  2. Inferior frontal sulcus
  3. Postcentral sulcus
  4. Intraparietal sulcus
  5. Superior temporal sulcus
  6. Inferior temporal sulcus
  7. Occipitotemporal sulcus
  8. Cingulate sulcus

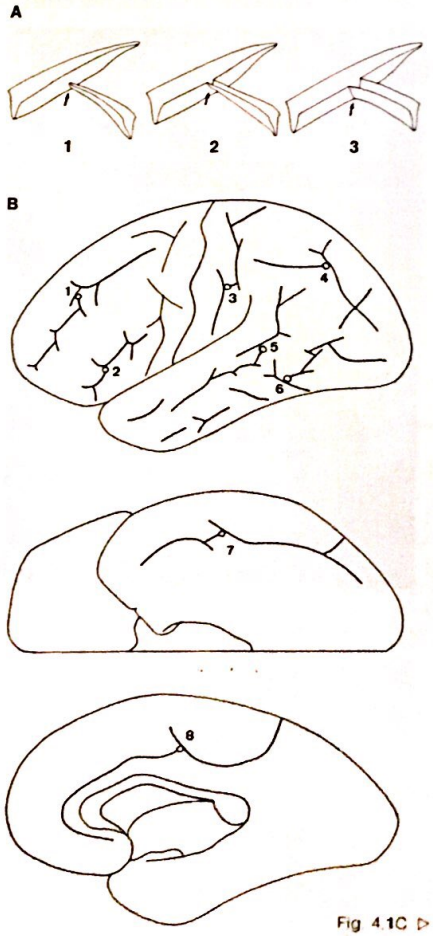

Fig. 4.1C ▷

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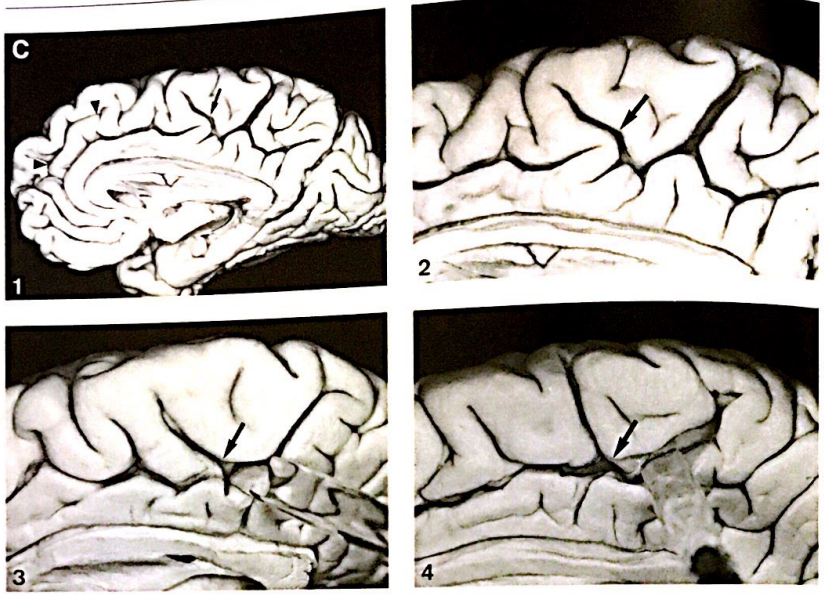
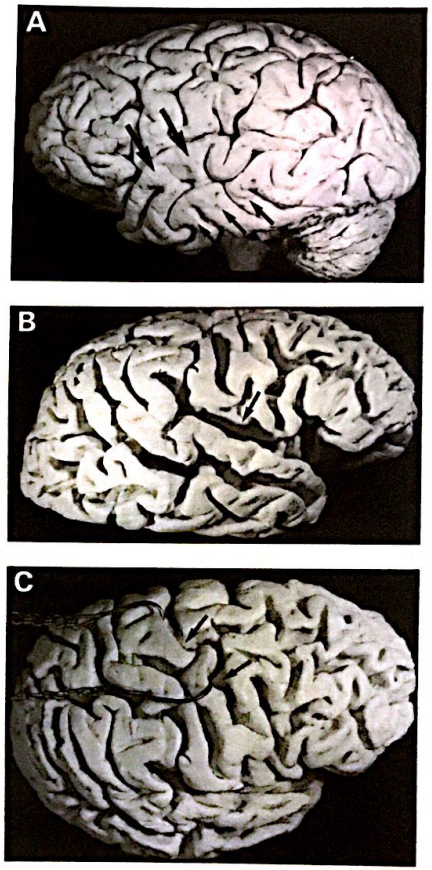


Figure 4.1C
III. The three types as displayed by the cingulate sulcus (C)
1. True interruption
2. True interruption (same case as no. 1)
3. Pseudocontinuation
4. True continuation

Figure 4.2 **Sulcal Interruption**
1. Form variation. Intimate interrelationships exist between the patterns of sulci and gyri. Not only the superficial pattern of the gyri, but also their internal structures (intrasulcal sulci and gyri) influence the sulcal pattern.

2. True interruption. The true interruption is caused by one or more transitional convolutions which connect two neighboring gyri. Figure 4.2A displays an interruption of the superior temporal sulcus by two transverse gyri (large arrows), and of the inferior temporal sulcus by three transverse gyri (small arrows).

3. Pseudointerruption. The pseudointerruption is caused by a deep, transverse (Fig. 4.2B) or S-shaped (Fig. 4.2C) operculated convolution. When the lips of the sulcus are closed, the sulcus appears continuous in nature, since only its floor is interrupted.



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Chapter 5
Types of Connections

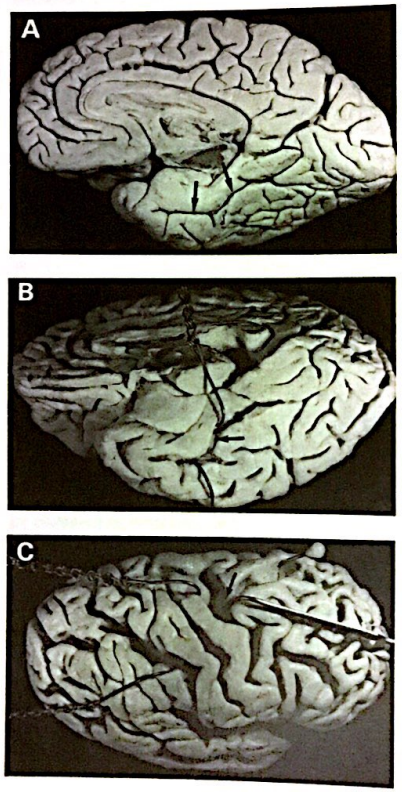

Figure 5.1 **Connections of the main sulci**
1. The end-to-end connection results from the union of two sulci which run in the same direction and at the same level, for example the union of the collateral sulcus with the rhinal sulcus (Fig. 5.1A). Sometimes, there is only a pseudoconnection, i.e. the furrow is interrupted by a deep operculated transverse intrasulcal gyrus (Fig. 5.1B).
2. The end-to-side connection is most frequently formed between the precentral and the frontal sulci, as well as between the postcentral and the interparietal sulci (Fig. 5.1C). The junction forms a right angle. Some authors therefore consider the horizontal part (superior frontal sulcus) as a side branch of the vertical part (superior precentral sulcus).

Figure 5.2
End-to-end connections

I. Types of end-to-end connection (A)
   1. True connection
   2. Pseudoconnection

II. Schemata and examples of true end-to-end connections (B,C)
   1. Intermediate frontal sulcus to superior frontal sulcus
   2. Inferior frontal sulcus to intermediate frontal sulcus
   3. Superior temporal sulcus to inferior temporal sulcus
   4. Olfactory sulcus to orbital sulcus
   5. Rhinal sulcus to collateral sulcus
   6. Anterior parolfactory sulcus to cingulate sulcus

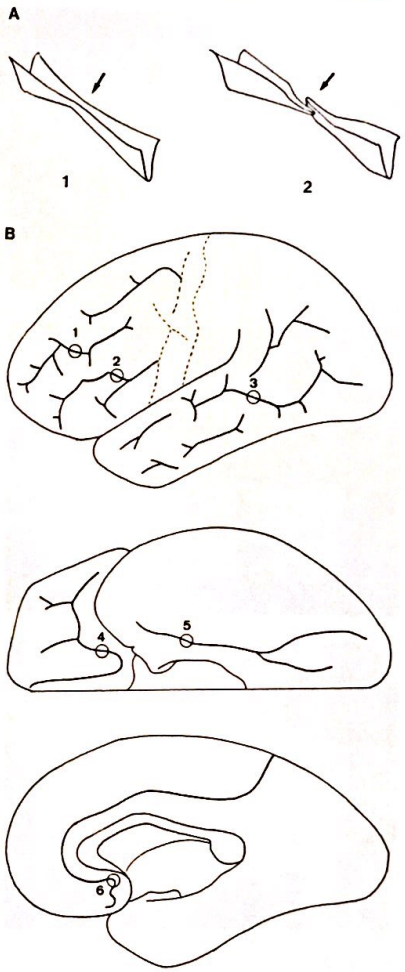

Fig. 5.2C–D ▷

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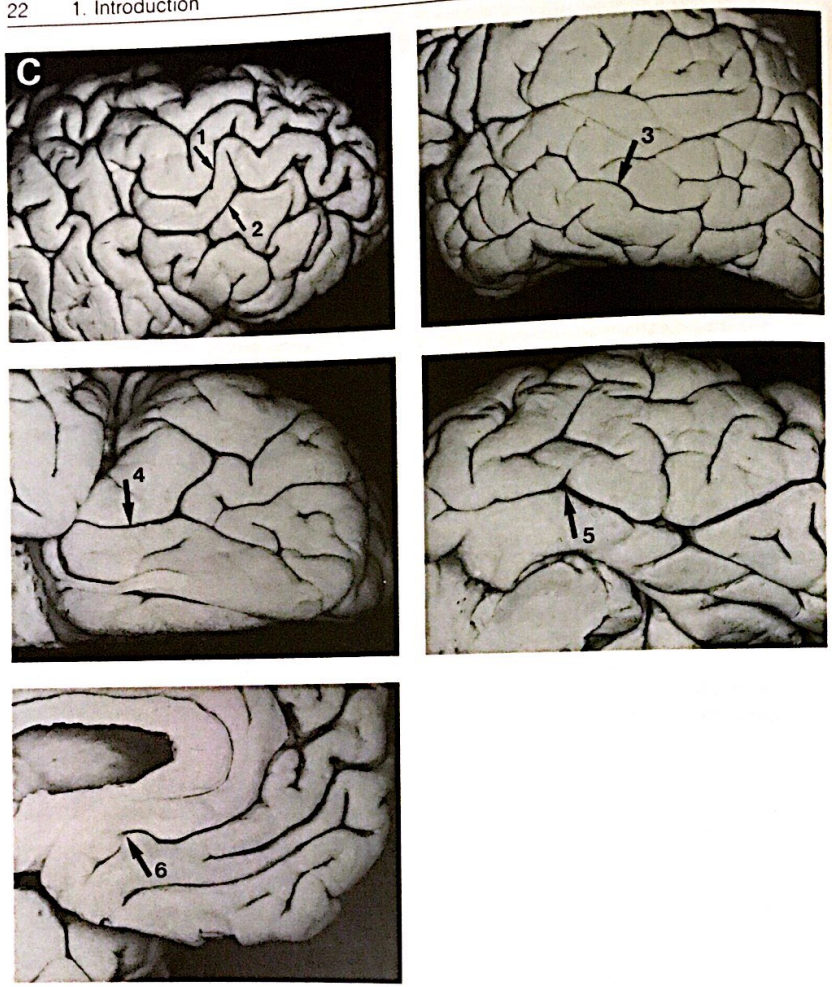

Figure 5.2C
1. Intermediate frontal sulcus to superior frontal sulcus
2. Inferior frontal sulcus to intermediate frontal sulcus
3. Superior temporal sulcus to inferior temporal sulcus
4. Olfactory sulcus to orbital sulcus
5. Rhinal sulcus to collateral sulcus
6. Anterior parolfactory sulcus to cingulate sulcus

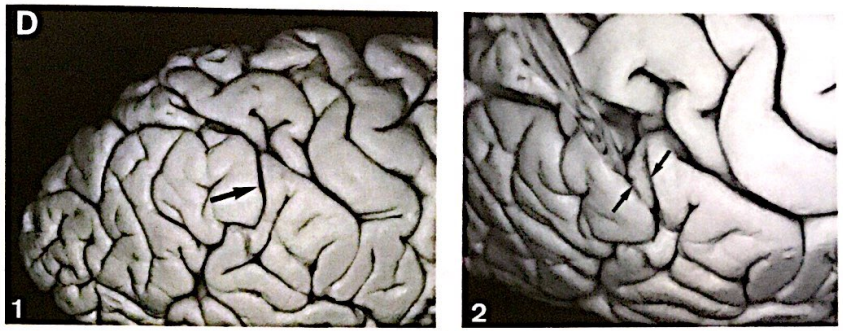

Figure 5.2D
III. Example of pseudo – end-to-end connection (D)
1. 2. Intraparietal sulcus to superior temporal sulcus

Note: pseudo – end-to-end connections are made by the operculation of the opposing cortices.

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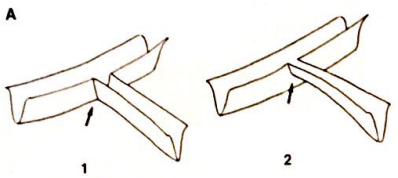

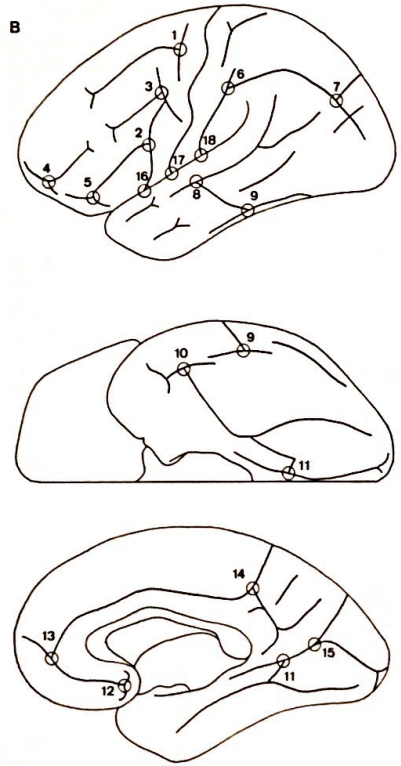

Figure 5.3
End-to-side connections

I. Types of end-to-side connection (A)
   1. True connection
   2. Pseudoconnection (deeply separated)

II. Schemata and examples of end-to-side connections (B)
   1. Superior precentral sulcus to superior frontal sulcus
   2. Inferior precentral sulcus to inferior frontal sulcus
   3. Inferior precentral sulcus to intermediate frontal sulcus
   4. Intermediate frontal sulcus to frontomarginal sulcus
   5. Inferior frontal sulcus to fronto-orbital sulcus
   6. Postcentral sulcus to intraparietal sulcus
   7. Intraparietal sulcus to parieto-occipital sulcus
   8. Superior temporal sulcus to inferior temporal sulcus
   9. Inferior temporal sulcus to occipitotemporal sulcus
   10. Collateral sulcus to occipitotemporal sulcus
   11. Collateral sulcus to calcarine sulcus
   12. Superior rostral sulcus to anterior parolfactory sulcus
   13. Superior rostral sulcus to cingulate sulcus
   14. Cingulate culcus to subparietal sulcus
   15. Calcarine sulcus to parieto-occipital sulcus
   16. Sylvian fissure to precentral sulcus
   17. Sylvian fissure to central sulcus
   18. Sylvian fissure to postcentral sulcus

III. Examples of true end-to-side connections (C)
   1. Superior precentral sulcus to superior frontal sulcus
   2. Collateral sulcus to occipitotemporal sulcus
   3. Superior rostral sulcus to cingulate sulcus
   4. Cingulate sulcus to subparietal sulcus

IV. Examples of pseudo – end-to-side connections (D)
   1. Superior precentral sulcus to superior frontal sulcus
   2. Collateral sulcus to occipitotemporal sulcus
   3. Superior rostral sulcus to cingulate sulcus
   4. Cingulate sulcus to subparietal sulcus
   5. Calcarine sulcus to parieto-occipital sulcus
   6. Sylvian fissure to precentral sulcus
   7. Sylvian fissure to central sulcus
   8. Sylvian fissure to postcentral sulcus

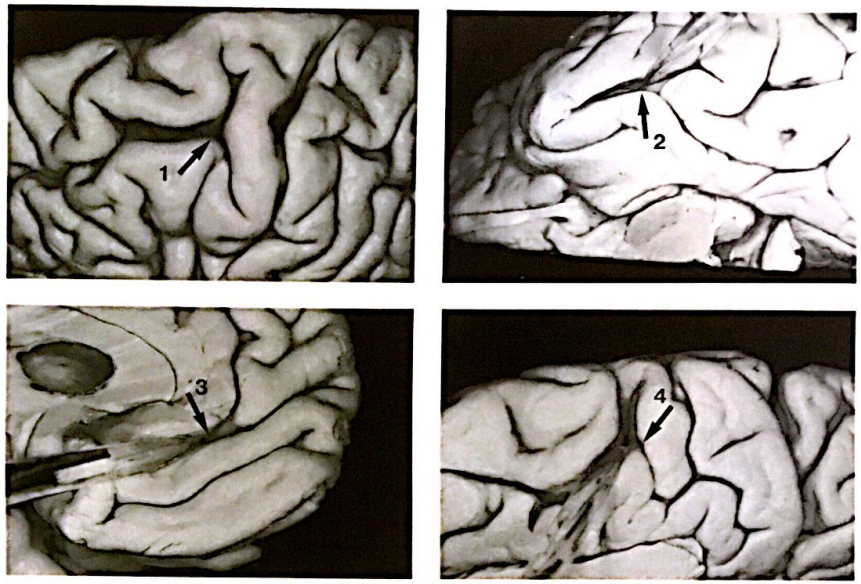

Fig. 5.3C
III. Examples of true end-to-side connections (C)
   1. Superior precentral sulcus to superior frontal sulcus
   2. Collateral sulcus to occipitotemporal sulcus
   3. Superior rostral sulcus to cingulate sulcus
   4. Cingulate sulcus to subparietal sulcus

Fig. 5.3D ▷

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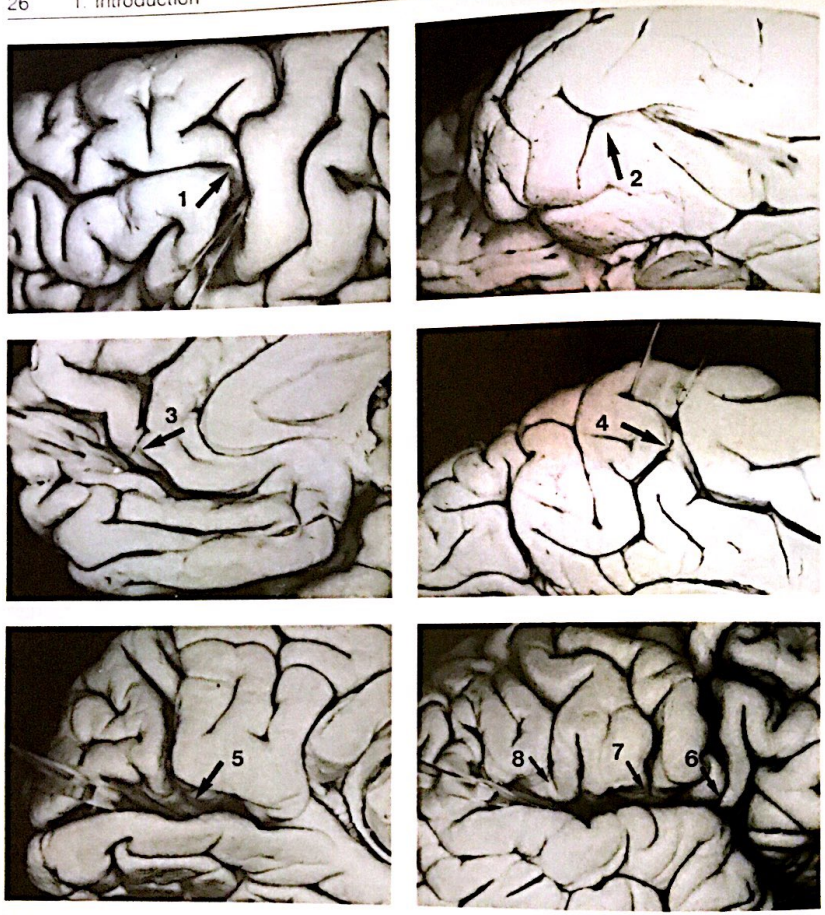

Fig. 5.3D

IV. Examples of pseudo – end-to-side connections (D)
1. Superior precentral sulcus to superior frontal sulcus
2. Collateral sulcus to occipitotemporal sulcus
3. Superior rostral sulcus to cingulate sulcus
4. Cingulate sulcus to subparietal sulcus
5. Calcarine sulcus to parieto-occipital sulcus
6. Sylvian fissure to precentral sulcus
7. Sylvian fissure to central sulcus
8. Sylvian fissure to postcentral sulcus

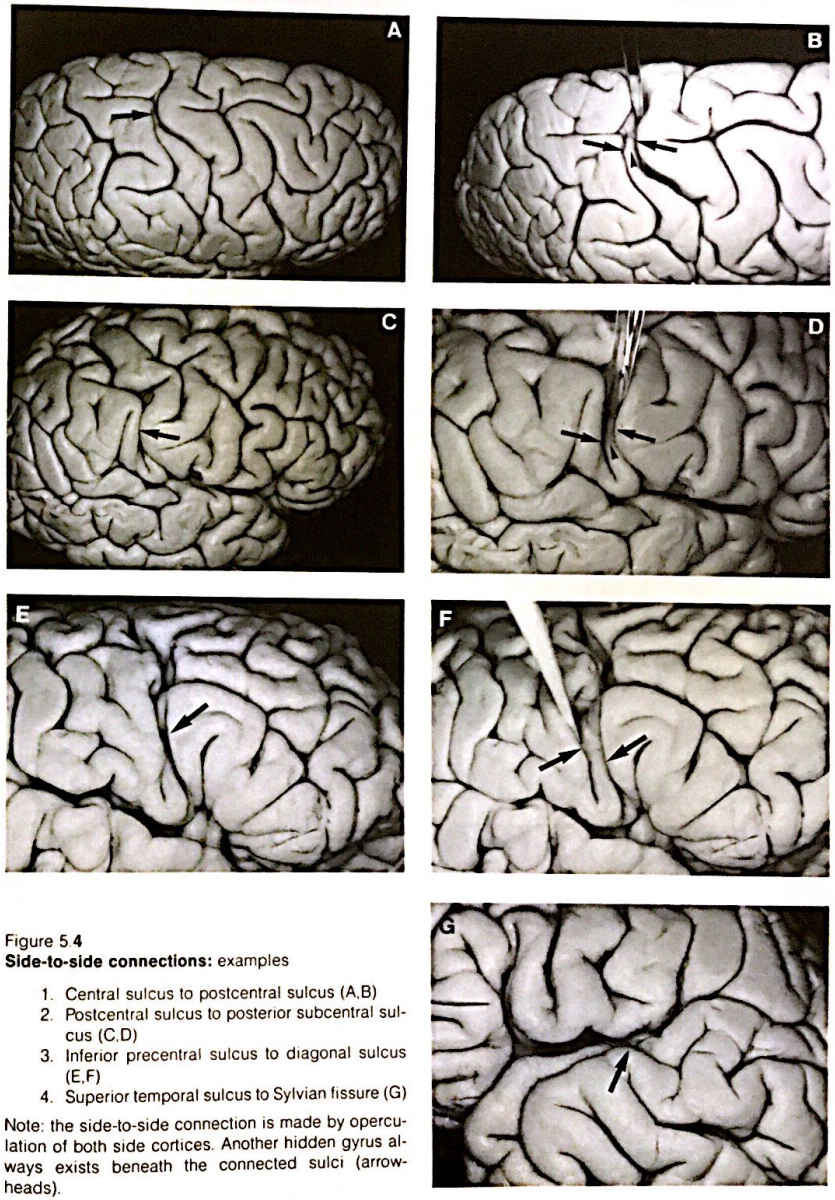

Figure 5.4
Side-to-side connections: examples

1. Central sulcus to postcentral sulcus (A,B)
2. Postcentral sulcus to posterior subcentral sulcus (C,D)
3. Inferior precentral sulcus to diagonal sulcus (E,F)
4. Superior temporal sulcus to Sylvian fissure (G)

Note: the side-to-side connection is made by operculation of both side cortices. Another hidden gyrus always exists beneath the connected sulci (arrowheads).

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Chapter 6
Types of Side Branches

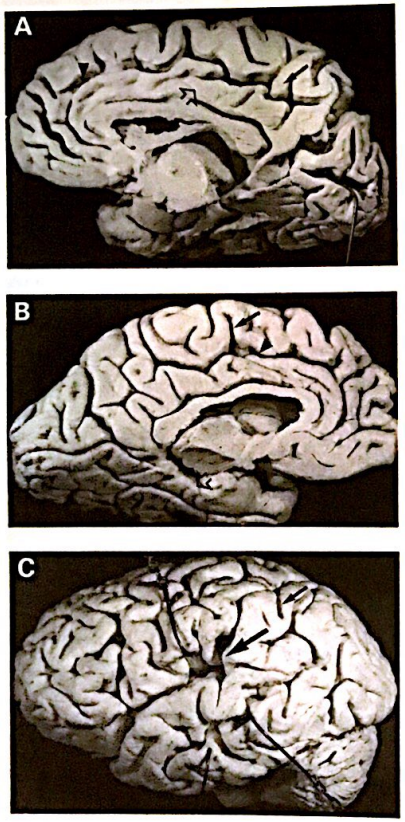

Figure 6.1 **Definitions of side branch types**

1. True side branches have the same depth as the main sulcus out of which they arise. They cut into the neighboring gyrus and enlarge the inner surface of the gyrus in question. The end of a side branch is surrounded by a V-shaped convolution. Therefore, the margin of a gyrus is mostly dentated. With the exceptions of the central, hippocampal, and olfactory sulci, all other sulci can have side branches (Fig. 6.1A–C, small arrows).

2. Pseudo-side branches can only be found on the frontoparietal operculum. They originate on the inner opercular surface and cut into the opercular margin. The inner ends of these sulci never reach the floor of the Sylvian fissure. Therefore, they appear to be side branches only when the lips of the Sylvian fissure are closed. The diagonal, anterior subcentral and posterior subcentral sulci are pseudo-side branches (Fig. 6.1C, large arrow).

3. Intrasulcal furrows separate the intrasulcal gyri. Their depth and length are variable. Short and shallow furrows remain intrasulcal and do not reach the gyral margin (Fig. 6.3B, arrowhead). The ends of longer and deeper furrows are visible on the margin of the gyri as incisures or notches. Incisures and notches can be found everywhere along interdentated gyri (Fig. 6.1A, arrowhead).

4. Connecting branches join two neighboring parallel sulci. Sometimes, they are interrupted by a deep operculated transverse gyrus (Fig. 4.1C, arrowheads).

5. Furrow-like impressions can be caused by stems and branches of arteries. They run most frequently along the cingulate gyrus, or cross the lingual and parahippocampal gyri (Fig. 6.1A,B, open arrows).

Figure 6.2
Types of side branches

I. Types of side branches (A)
   1. True side branch
   2. Pseudo-side branch (deeply separated)

II. Schemata and examples of named side branches (B,C)
   a Mostly true side branches
   1. Primary intermediate sulcus
   2. Secondary intermediate sulcus
   3. Transverse occipital sulcus
   4. Parahippocampal ramus
   5. Sulcus of the preoccipital incisura
   6. Paracentral sulcus
   7. Horizontal ramus
   8. Ascending ramus
   9. Posterior subcentral sulcus
   10. Transverse temporal sulcus
   b Mostly pseudo-side branches
   11. Diagonal sulcus
   12. Anterior subcentral sulcus

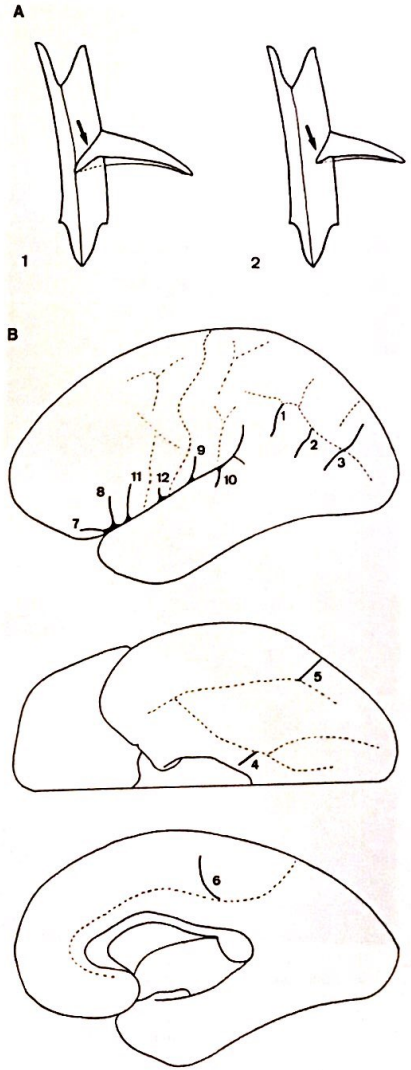

Fig. 6.2C ▷

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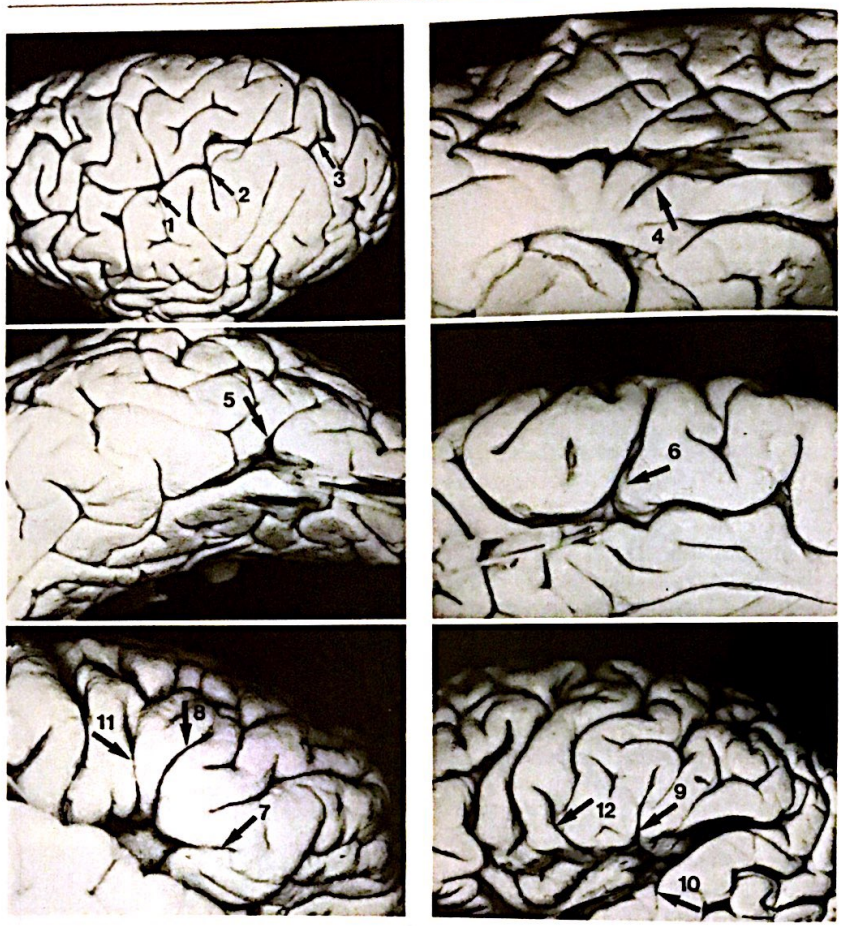

Figure 6.2C
a Mostly true side branches
1. Primary intermediate sulcus
2. Secondary intermediate sulcus
3. Transverse occipital sulcus
4. Parahippocampal ramus
5. Sulcus of the preoccipital incisura
6. Paracentral sulcus
7. Horizontal ramus
8. Ascending ramus
9. Posterior subcentral sulcus
10. Transverse temporal sulcus
b Mostly pseudo-side branches
11. Diagonal sulcus
12. Anterior subcentral sulcus

Figure 6.3
Inner structure of the sulcal spaces

I. Mold of a sulcus and inner surface of a gyrus (A,B)
1. Main sulcus
2. Side branches
3. Intrasulcal furrows
4. Length of a straight surface

II. Inner surfaces of the central sulcus (C,D)

III. Cog-wheel structure of opposing gyral surfaces (E,F)

Note: the mold of a sulcus, with its shallow and deep side branches, shows a herring-bone pattern (Fig. 6.3A). Due to the shorter and longer intrasulcal furrows, the inner surfaces of the gyri become undulating (Fig. 6.3B-D, Fig. 6.3D, arrow). The wave-like opposing surfaces of the gyri interlock like cog-wheels (Fig. 6.3E,F, arrows). Because of the wave-like form of the gyri, their inner surface enlarges considerably compared to a straight surface (Fig. 6.3B). The straight length of the central sulcus on Fig. 6.3C measures 8.2 cm. However, the undulated length is 11 cm. Often, the closed central sulcus is more or less straight, but its inner surface is undulating, as seen when Figures 5.1C and 6.3D (same cerebral hemisphere) are compared. The straight length in this case measures 8 cm, whereas the waved real length is 11.2 cm. The surface enlarges even more due to lateral branches. The sulci and gyri show the same structure in all brain areas, i.e. the sulci have a herring-bone pattern, and the gyri have a cog-wheel arrangement.

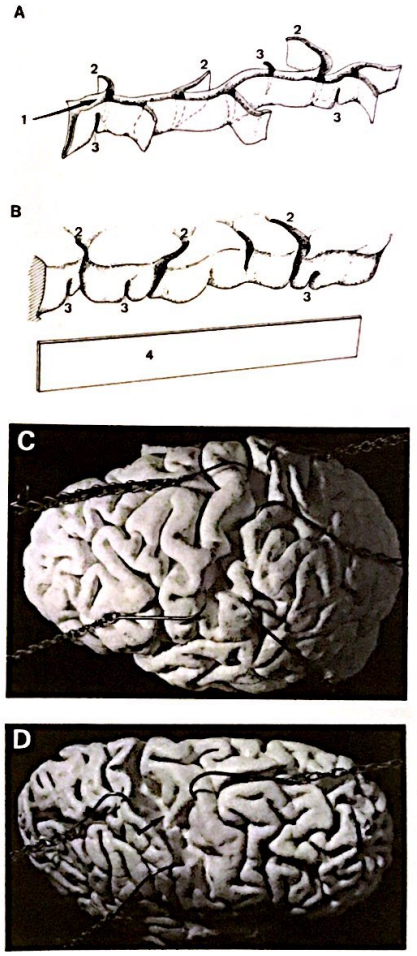

Fig. 6.3E,F ▷

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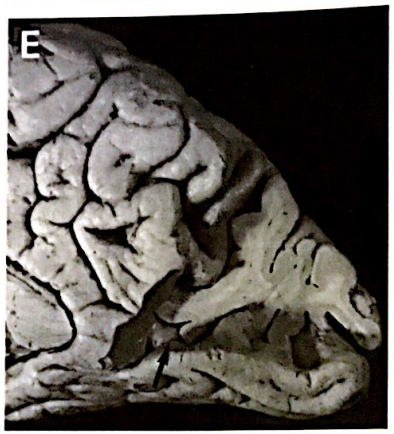


Figure 6.3E,F
The wave-like opposing surfaces of the gyri interlock like cog-wheels (Fig. 6.3E,F, arrows).

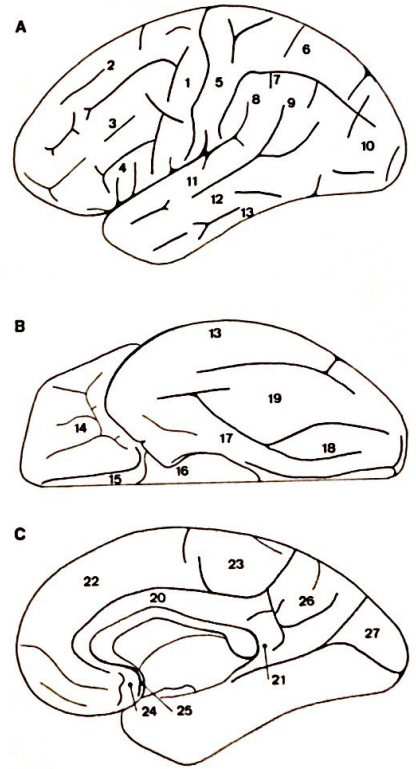
Chapter 7
Nomenclature of the Gyri

Figure 7.1
Nomenclature of the gyri

I. Lateral Surface (A)
1. Precentral gyrus
2. Superior frontal gyrus
3. Intermediate frontal gyrus
4. Inferior frontal gyrus
5. Postcentral gyrus
6. Superior parietal lobule
7. Inferior parietal lobule
8. Supramarginal gyrus
9. Angular gyrus
10. Occipital lobe
11. Superior temporal gyrus
12. Intermediate temporal gyrus
13. Inferior temporal gyrus

II. Inferior Surface (B)
14. Orbital gyri
15. Rectal gyrus
16. Uncus
17. Parahippocampal gyrus
18. Lingual gyrus (medial occipitotemporal gyrus)
19. Fusiform gyrus (lateral occipitotemporal gyrus)

III. Medial Surface (C)
20. Cingulate gyrus
21. Isthmus of the cingulate gyrus
22. Medial frontal gyrus
23. Paracentral lobule
24. Subcallosal area
25. Paraterminal gyrus
26. Precuneus
27. Cuneus



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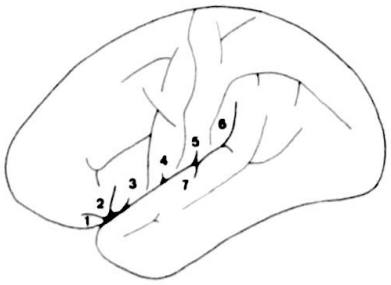

Figure 7.2
Nomenclature of the Sylvian fissure operculum

I. Frontal operculum
   1. Pars orbitalis
   2. Pars triangularis

II. Frontoparietal operculum
   3. Pars opercularis
   4. Precentral gyrus
   5. Postcentral gyrus
   6. Inferior parietal lobule

III. Temporal operculum
   7. Superior temporal gyrus

2

Sulcal Patterns of the Cerebral Hemispheres: Lateral Surface

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Chapter 8
Frontal Lobe: Lateral Surface

Figure 8.1 **Central sulcus**

The central sulcus is the most important and constant landmark on the convexity of the brain, since it divides the sensory and motor areas and contains a great part of these regions within its walls. It extends obliquely across the lateral convex surface of the hemisphere at an angle of approximately 7 degrees from the midsagittal line (in contrast to 45 degrees in the 5-month embryonic stage). It is more or less sinuous, showing two sharp curves which are called the superior and inferior genu, according to Broca. The concavity of the superior knee is directed anteriorly, and that of the inferior knee posteriorly. Testut-Laterjet and Paturet designated three curves, an upper and a lower knee (*genou supérieur* and *inférieur*) with an anteriorly-directed convexity, and a middle knee (*genou moyen*) with a posteriorly-directed convexity. The upper knee is always well defined, in contrast to the lower. Due to the opposed curvatures, the precentral and postcentral gyri are interdented and form so-called interlocking gyri.

The central sulcus is generally continuous. An interrupted sulcus was found unilaterally by Retzius and Eberstaller in only 1% of cases. The interruption is caused by a non-operculated deep convolution, similar to early development stages. Depending upon the height of the deep convolution, the central sulcus can be partially or completely interrupted.

According to Retzius, the primordium of the central sulcus first appears between the fifth and sixth months of fetal life. During the sixth month, the upper end approaches the superior margin of the hemisphere, either by elongation or by the appearance of a medial-lying depression. Cunningham explains the appearance of an interrupted sulcus by means of this bipartite stage. The central sulcus attains its definitive depth and curvature in the eighth month.

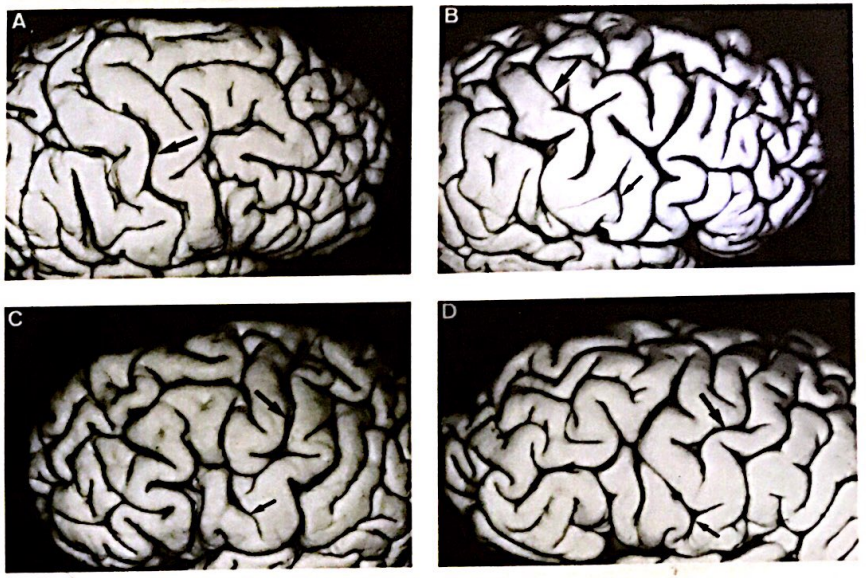

Figure 8.1
Central sulcus: patterns
(incidence rates in %)

Interruptions
1. Continuous (A)
   right – 92%; left – 92%
2. Interrupted (B)
   right – 8%; left – 0%
3. Inferior portion continuous with the inferior precentral sulcus (C,D)
   right – 0%; left – 8%

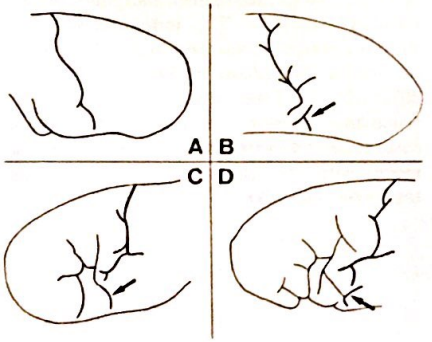

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Figure 8.2 **Central sulcus: inferior and superior ends**

The inferior end of the central sulcus does not usually reach the Sylvian fissure. Consequently, a small bridge connects the inferior ends of the precentral and postcentral gyri. This bridge is called *pli de passage frontopariétal inférieur* or *opercule Rolandique* in the French literature. Cunningham found anastamoses with the Sylvian fissure in 19% of cases. According to Retzius, the central sulcus anastamoses with the anterior subcentral sulcus in 16%, and with the posterior subcentral sulcus in 7% of cases. Eberstaller mentions an occasional anastomosis with the diagonal sulcus (cited as the inferior transverse sulcus by Lang).

The superior end of the central sulcus extends to the medial surface in nearly all cases according to Eberstaller, and in 88% of cases according to Lang. Retzius reports that the central sulcus extends to the medial surface in 64% of cases, and that it just reaches or merely nicks the superior margin of the hemisphere in 16%. The indentation of the superior margin is named *crochet de Rolando* or *crochet Rolandique* by French authors. In 20% of cases, the central sulcus does not reach the superior margin. In some of these cases it can end with a bifurcation. An anastamosis with the cingulate sulcus was only found by Benedikt.

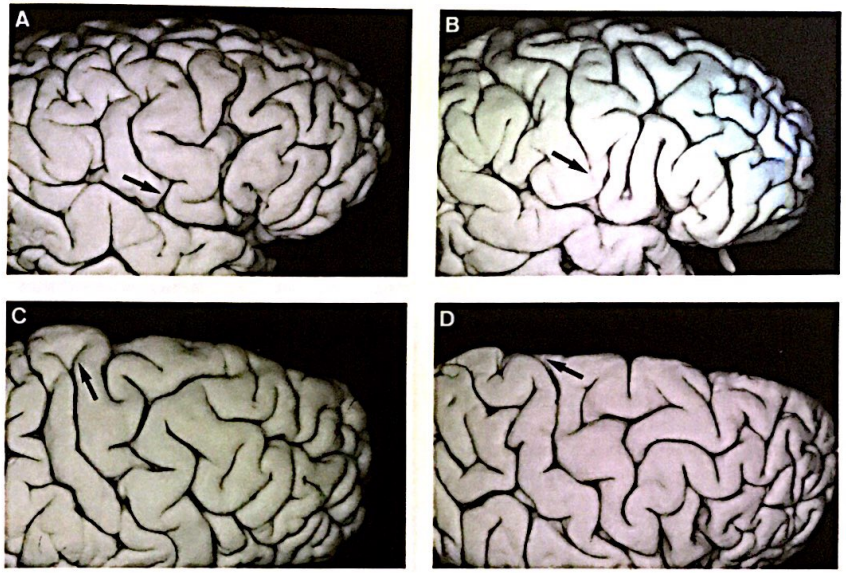

Figure 8.2
Central Sulcus: inferior and superior ends
(incidence rates in %)

I. Inferior end
  1. Extension into the Sylvian fissure (A)
     right – 16%; left – 16%
  2. Direction
     a Anterior (B)
       right – 40%; left – 60%
     b Posterior (A)
       right – 60%; left – 40%
  3. Shape
     a Straight (B)
       right – 52%; left – 80%
     b Y-shape
       right – 28%; left – 0%
     c T-shape
       right – 20%; left – 20%

II. Superior end
  1. Extension to the medial surface (D)
     right – 56%; left – 72%
  2. Shape
     a Straight (D)
       right – 84%; left – 96%
     b Y-shape (C)
       right – 12%; left – 4%
     c T-shape
       right – 4%; left – 0%

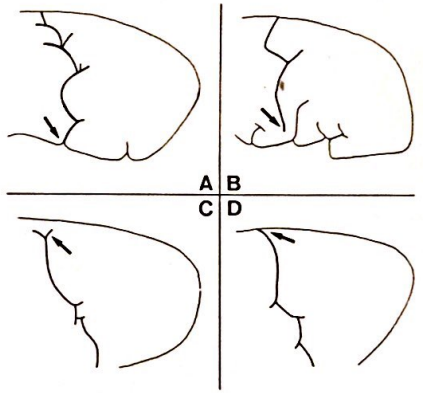

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Figure 8.3 **Central sulcus: side branches and connections**

According to Retzius, the central sulcus is an independent furrow in 64% of cases (i.e. it has no real side branches), but has only indentations caused by the superficial ends of intrasulcal furrows which nick the margins of the precentral and postcentral gyri. The central sulcus anastamoses with the precentral sulcus in 24% of cases (upper portion in 18%, and lower portion in 6%), and with the postcentral sulcus in 11% of cases (upper portion in 3%, and lower portion in 8%). Eberstaller found connections between the central and precentral sulci in 15% of cases. According to Eberstaller, the anastomotic furrows are not deep on the precentral and postcentral gyri, and therefore maintain their continuity via a depressed, deep-lying gyral portion.

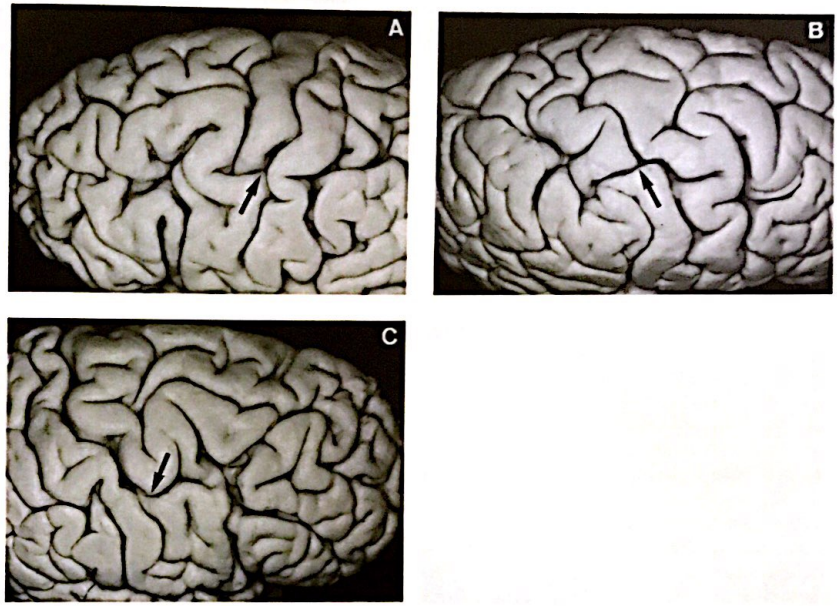

Figure 8.3
Central sulcus: side branches and connections
(incidence rates in %)

I. Side branches
1. Over postcentral gyrus

Number	*Right*	*Left*
0	12%	12%
1	52%	36%
2	20%	48%
3	12%	4%
4	4%	0%

2. Over precentral gyrus

Number	*Right*	*Left*
0	16%	20%
1	36%	20%
2	32%	32%
3	12%	24%
4	4%	4%

II. Connections
1. With precentral gyrus (A)
right – 8% left – 28%
2. With postcentral gyrus (B)
right – 8% left – 8%
3. With small free sulcus over precentral gyrus (C)
right – 20% left – 8%

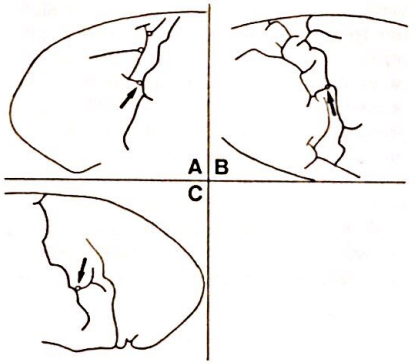

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Figure 8.4 **Precentral sulcus: patterns**

The precentral sulcus (*sillon prérolandique* in French) marks the boundary between the precentral and the three frontal gyri. It lies rostral and roughly parallel to the central sulcus. Rarely, it exists as an unbroken sulcus, but typically it is divided into two or more segments. Most commonly, it consists of two parts, the superior and inferior precentral sulci, which are separated by a transverse connection between the precentral and intermediate frontal gyri.

The precentral sulcus develops from two separate primordia which appear in the sixth fetal month. Both of them have, by this time, a horizontal branch representing the primordia of the superior and inferior frontal sulci. In the early postuterine stage, a small isolated sulcus appears, the marginal precentral sulcus. This sulcus carries the line of the superior precentral sulcus towards the superior margin of the hemisphere (Turner). In the late postuterine stage, an inconstant sulcus appears between the superior and inferior precentral sulci: the intermediate precentral sulcus. The marginal precentral sulcus changes its direction from vertical to horizontal in the sagittal plane. Running horizontally, it then lies between the superior margin and the upper end of the superior precentral sulcus. The medial precentral sulcus of Eberstaller notches the superior margin of the hemisphere and lies somewhat anterior to the upper end of the superior precentral sulcus. It can always be seen on the medial surface. In some cases, it extends onto the convex surface, while in other cases it only nicks the superior margin.

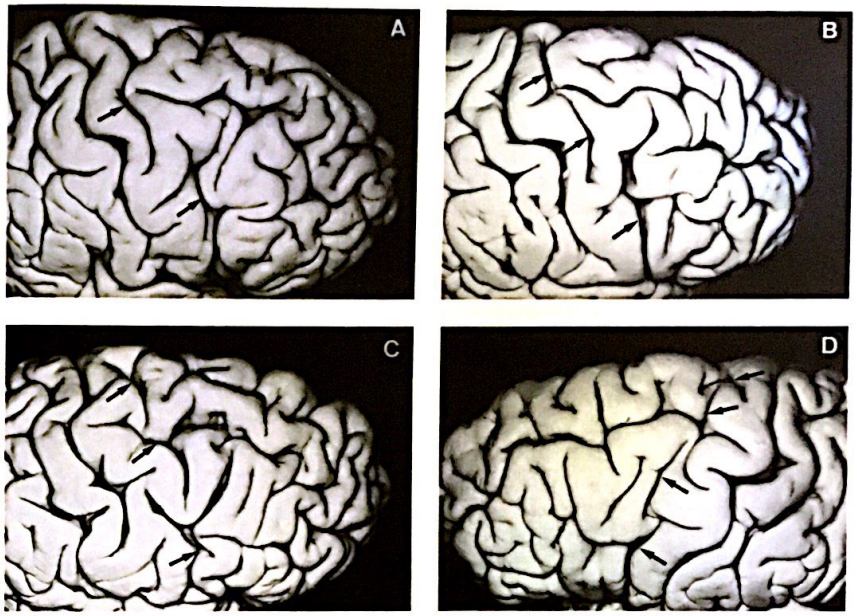


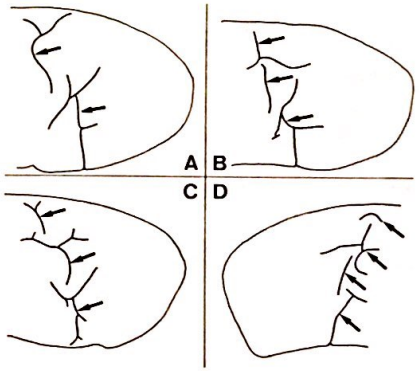
Figure 8.4
Precentral sulcus: patterns
(incidence rates in %)

I. Two-segment type (A)
Superior precentral sulcus + inferior precentral sulcus
Right – 48%; left – 64%

II. Three-segment type (B)
Superior precentral sulcus + inferior precentral sulcus + intermediate precentral sulcus
Right – 12%; left – 16%

III. Three-segment type (C)
Superior precentral sulcus + inferior precentral sulcus + marginal precentral sulcus
Right – 36%; left – 16%

IV. Four-segment type (D)
Superior precentral sulcus + inferior precentral sulcus + marginal precentral sulcus + intermediate precentral sulcus
Right – 0%; left – 4%



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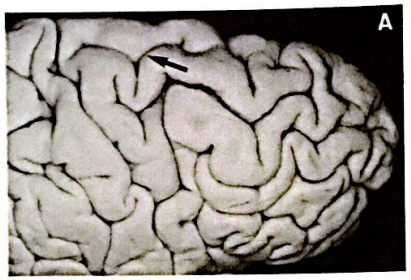
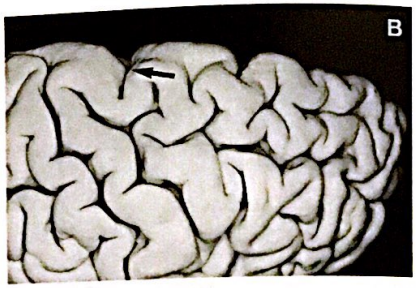




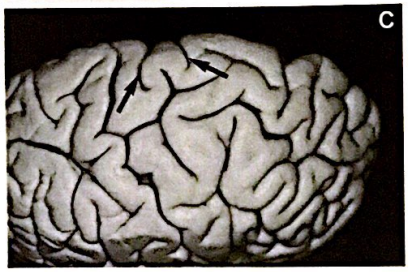


Figure 8.5
Precentral Sulcus: patterns
(incidence rates in%)

I. Marginal precentral sulcus (A)
Right – 36%; left – 16%

II. Medial precentral sulcus (B,C)

Number	*Right*	*Left*
0	8%	20%
1(B)	72%	80%
2(C)	20%	0%

Note: the marginal precentral sulcus is a horizontally-oriented sulcus, over the lateral surface and above the superior precentral sulcus. The medial precentral sulcus notches the superior margin of the hemisphere above the superior precentral sulcus.

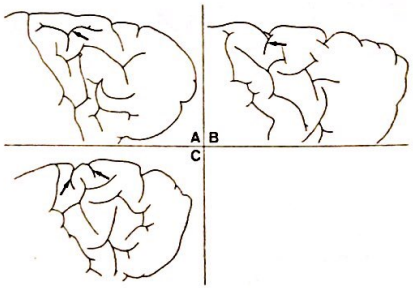
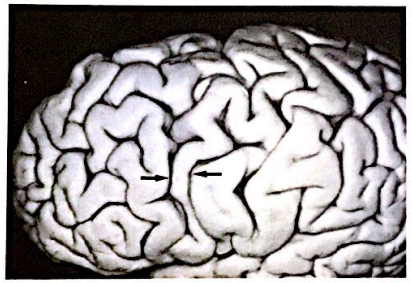
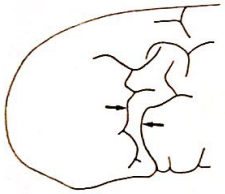


Figure 8.6 **Precentral sulcus: patterns**
(incidence rates in %)

III. Double parallel type
Right – 4%; left – 4%





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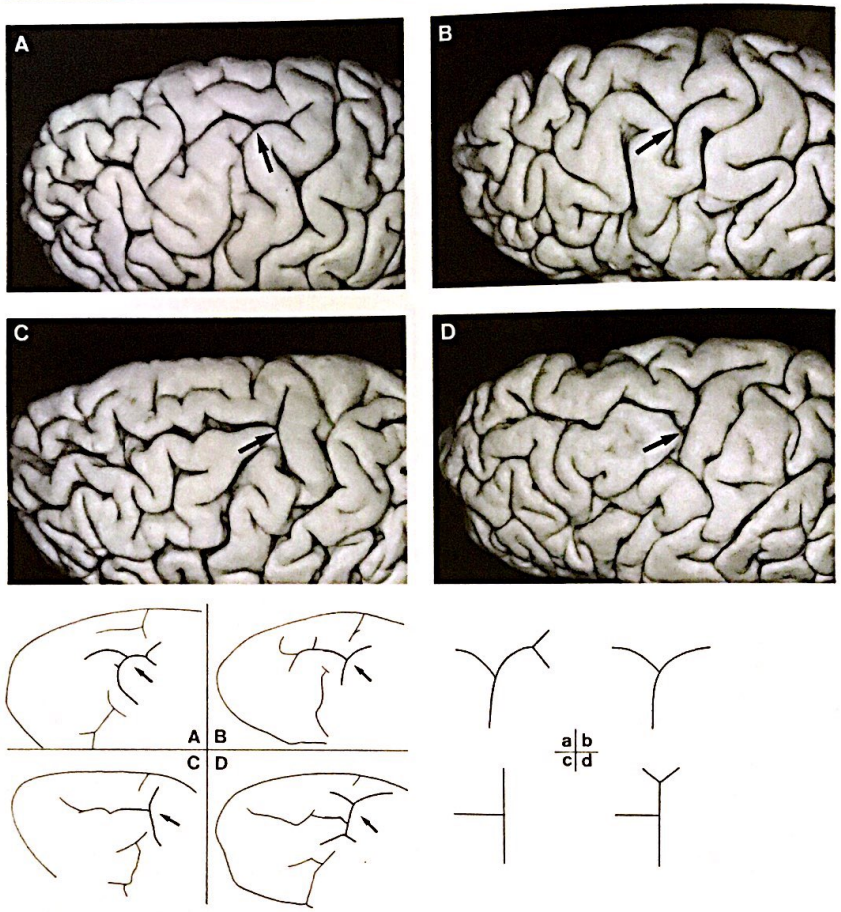

Figure 8.7
Precentral sulcus: pattern of superior precentral sulcus

I. Pattern (incidence rates in %)
   1. Arcuate termination type
      Right – 28%; left – 20% (A=a)
      Right – 32%; left – 20% (B=b)
   2. T-shaped side anastamosis (C=c)
      Right – 20%; left – 32%
   3. T-shaped side anastamosis with Y-shaped end (D=d)
      Right – 20%; left – 28%

II. Superior end of superior precentral sulcus
Only one superior end in the series extended to the medial surface. All others terminated at or before reaching the superior margin of the hemisphere.

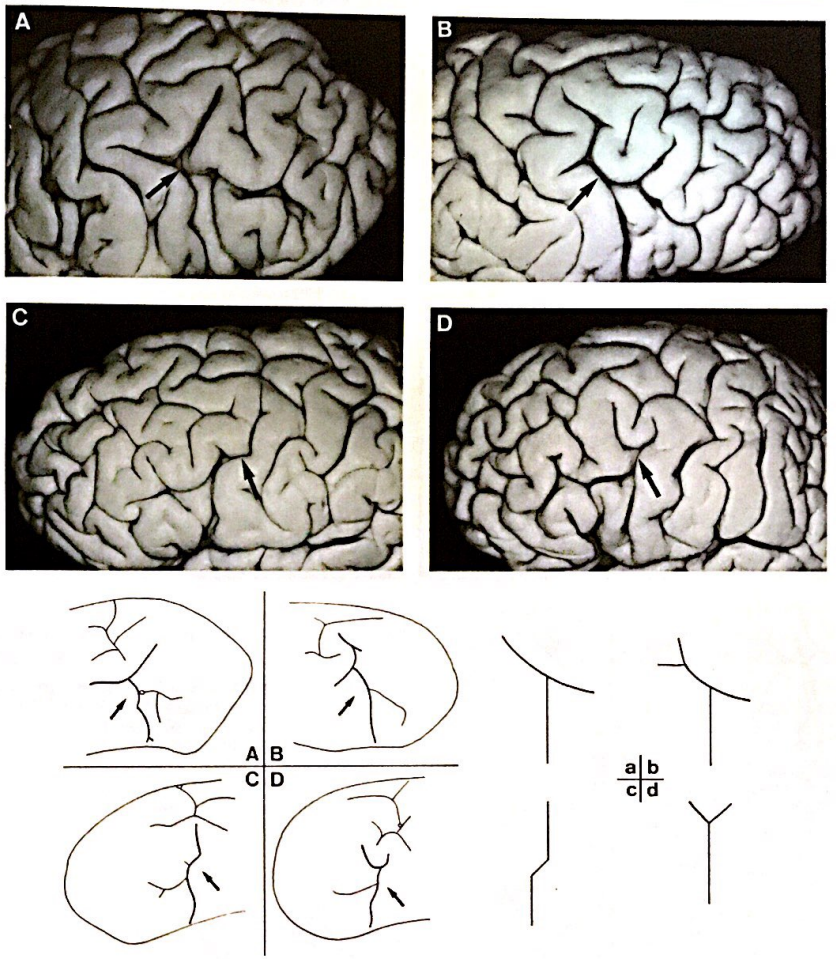

Figure 8.8
Precentral sulcus: pattern of inferior precentral sulcus

I. Pattern (incidence rates in %)
   1. Arcuate form (A=a)
      Right – 44%; left – 32%
   2. Ramified form (B=b)
      Right – 28%; left – 36%
   3. Bayonet form (C=c)
      Right – 28%; left – 20%
   4. Y-shaped end (D=d)
      Right – 0%; left – 12%

II. Inferior end of inferior precentral sulcus
   1. Extension into the Sylvian fissure (A–C)
      Right – 28%; left – 20%
   2. Straight shape (B,C)
      Right – 72%; left 84%
   3. Y-shape (A,D)
      Right – 28%; left – 16%

III. Superior end of inferior precentral sulcus
In 96% of cases, the superior end projected anteriorly to the inferior aspect of the superior precentral sulcus (A,B,D).

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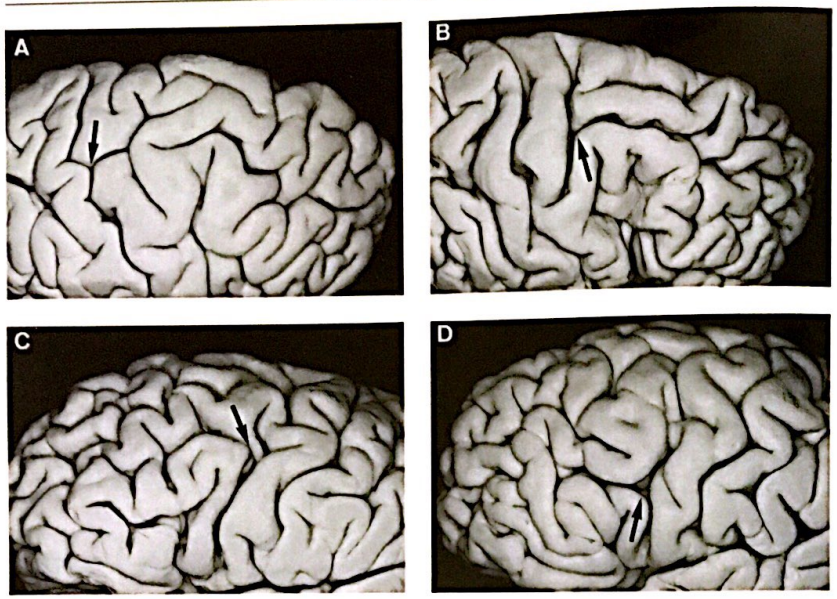


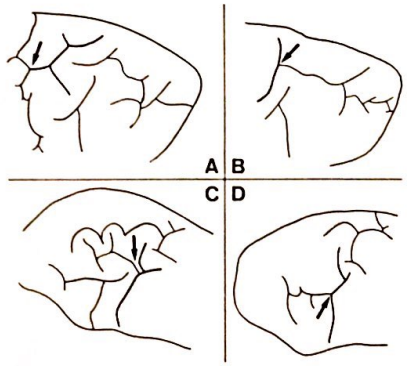


Figure 8.9
Precentral sulcus: connections
(incidence rates in %)

1. With the central sulcus (A)
   Right – 12%; left – 28%
2. With the superior frontal sulcus (B)
   Right – 92%; left – 100%
3. With the intermediate frontal sulcus (C)
   Right – 36%; left – 44%
4. With the inferior frontal sulcus (D)
   Right – 92%; left - 88%

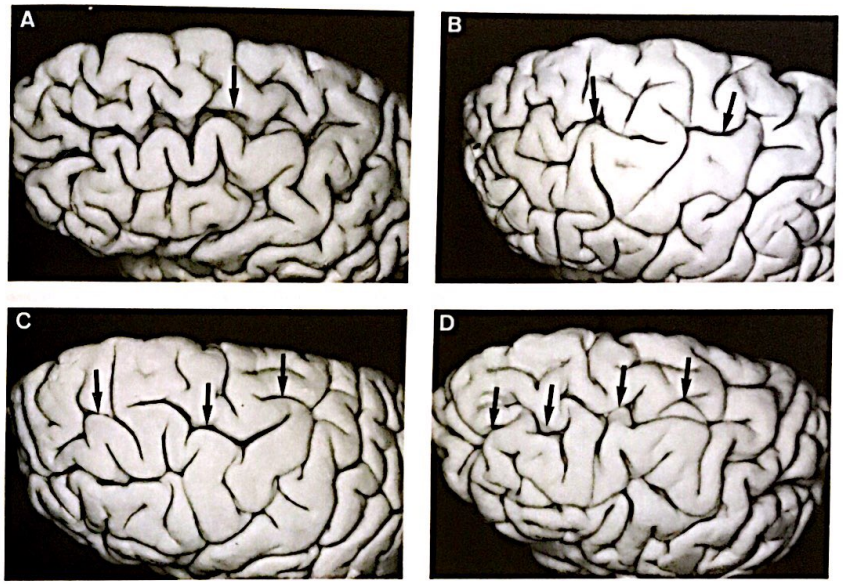
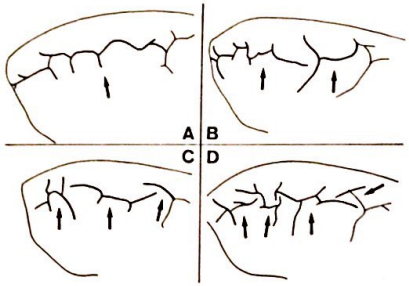


Figure 8.10
Superior frontal sulcus: patterns
(incidence rates in %)

I. Interruption of the superior frontal sulcus
   1. Continuous sulcus (A)
      Right – 40%; left – 32%
   2. Interrupted to two segments (B)
      Right – 52%; left – 36%
   3. Interrupted to three segments (C)
      Right – 8%; left – 28%
   4. Interrupted to four segments (D)
      Right – 0%; left - 4%

II. Overlapping of interrupted segments
   1. Overlapped (C.D)
      Right – 36%; left – 44%
   2. No overlapping present (B)
      Right – 24%; left - 32%



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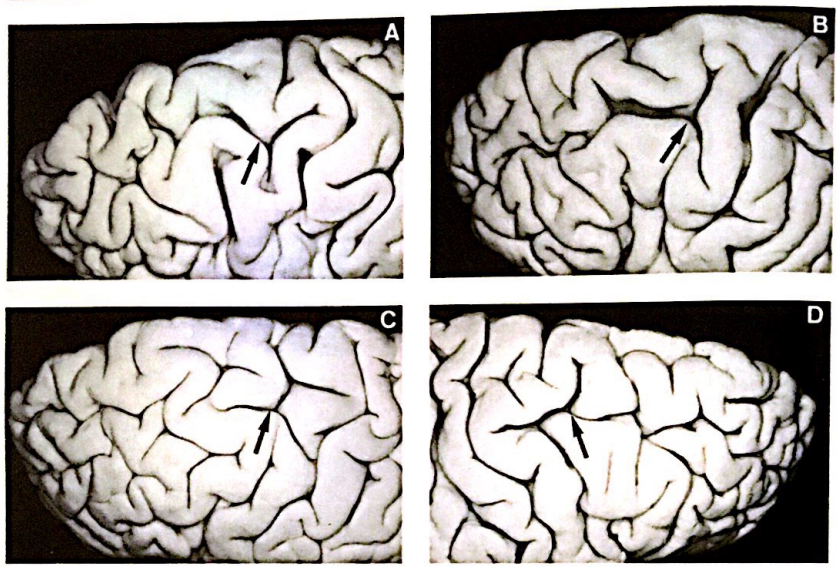


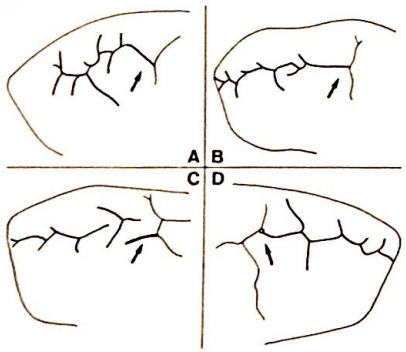


Figure 8.**11**
Superior frontal sulcus: posterior end
(incidence rates in %)

I. Connection with the precentral sulcus
   1. No connection
      Right – 8%; left – 0%
   2. Type A
      Right – 56%; left – 48%
   3. Type B
      Right – 32%; left – 48%
   4. Type C
      Right – 0%; left – 4%
   5. Type D
      Right – 4%; left – 0%

II. Pseudoconnection with the precentral sulcus (D)
   Right – 12%; left - 12%

III. Relative lengths of segments with true connections to the superior precentral sulcus
   1. Short (C)
      Right – 12%; left – 32%
   2. Middle
      Right – 36%; left – 16%
   3. Long (B)
      Right – 32%; left – 40%

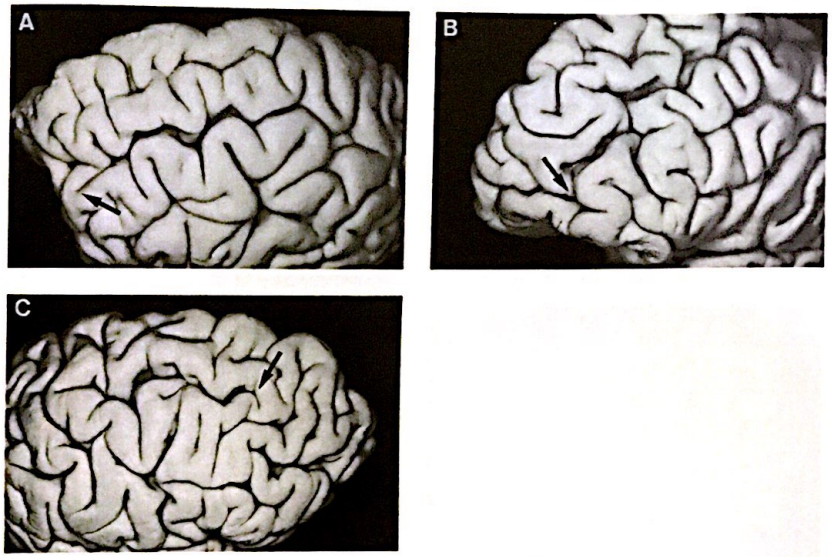
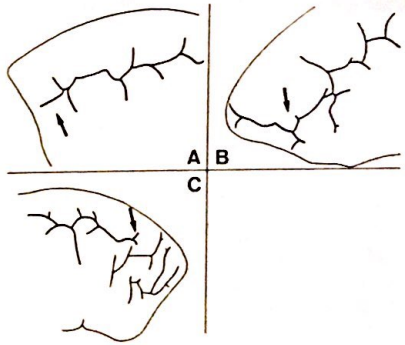


Figure 8.**12**
Superior frontal sulcus: anterior end
(incidence rates in %)

Position of the end-point
   1. Near the orbital margin of the hemisphere (A)
      Right – 40%; left – 44%
   2. Connects with the frontomarginal sulcus (B)
      Right – 16%; left – 44%
   3. Far posterior to the orbital margin of the hemisphere (C)
      Right – 44%; left – 12%



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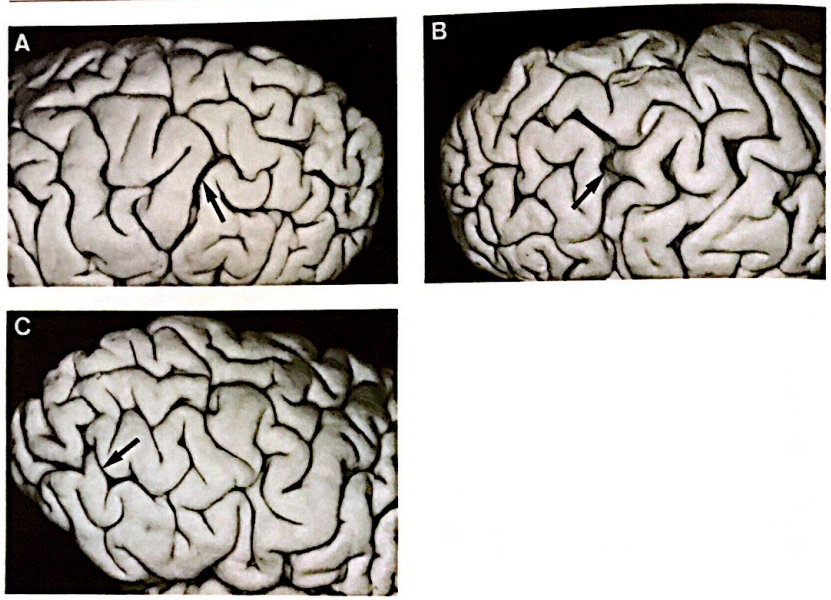


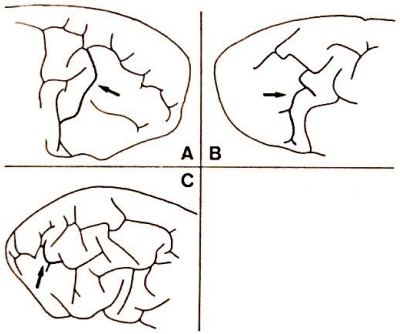


Figure 8.**13**
Superior frontal sulcus: side branches and connections
(incidence rates in %)

I. Side branches
1. Upward side branches

Number	*Right*	*Left*
1	24%	4%
2	28%	16%
3	24%	12%
4	16%	28%
5	4%	20%
6	4%	12%
7	0%	8%

2. Downward side branches

Number	*Right*	*Left*
1	4%	4%
2	40%	4%
3	32%	32%
4	16%	32%
5	8%	16%
6	0%	8%
7	0%	4%

II. Connection with the inferior frontal sulcus
1. Via the posterior middle frontal gyrus (A,B)
Right – 4%; left – 4%
2. Via the anterior middle frontal gyrus (C)
Right – 4%; left – 8%

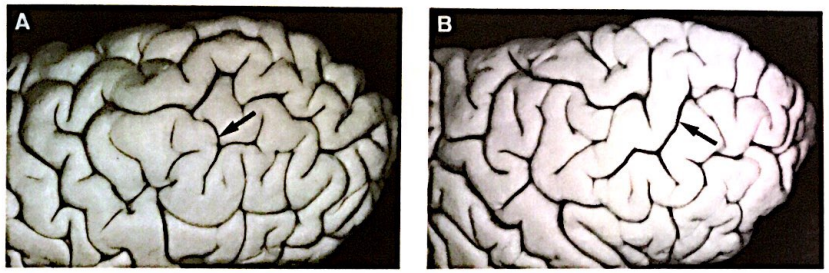
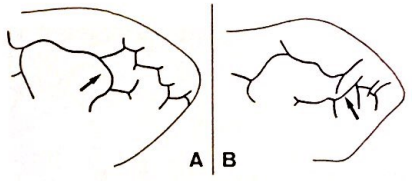


Figure 8.**14**
Superior frontal sulcus: connections
(continued)



III. Connection with the intermediate frontal sulcus
1. Superior frontal sulcus to intermediate frontal sulcus (A)
Right – 12%; left – 4%
2. Intermediate frontal sulcus to superior frontal sulcus (B)
Right – 8%; left – 28%

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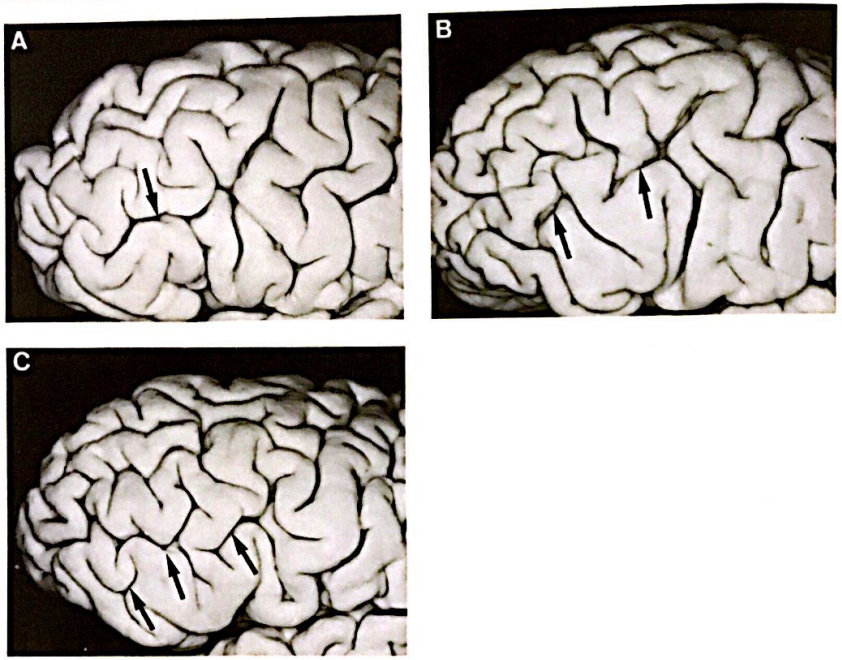


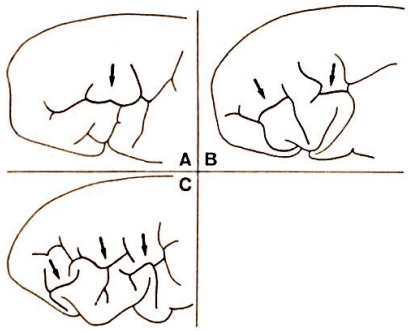


Figure 8.15
Inferior Frontal Sulcus: patterns
(incidence rates in %)

1. Continuous (A)
   Right – 56%; left 40%
2. Interrupted to two segments (B)
   Right – 32%; left – 32%
3. Interrupted to three segments (C)
   Right – 8%; left – 28%
4. Interrupted to four segments
   Right – 4%; left – 0%

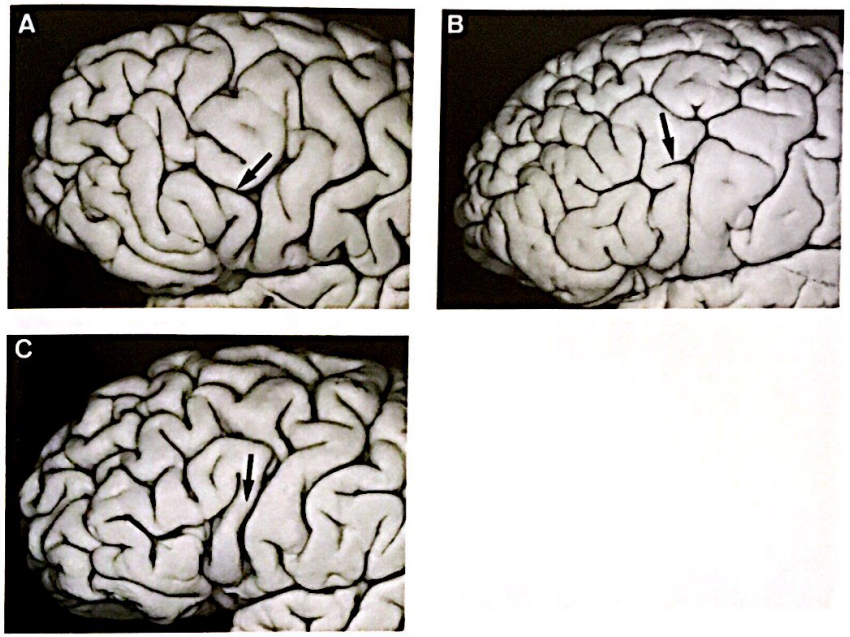
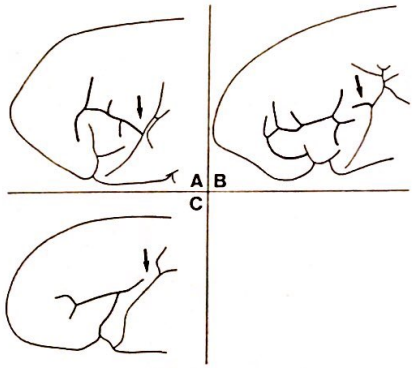


Figure 8.16
Inferior frontal sulcus: posterior end
Connection with the inferior precentral sulcus

1. True connection (A,B)
   Long (A): right – 40%; left – 68%
   Short (B), right – 28%; left – 8%
2. Pseudoconnection
   Right – 20%; left – 12%
3. No connection (C)
   Right – 12%; left – 12%



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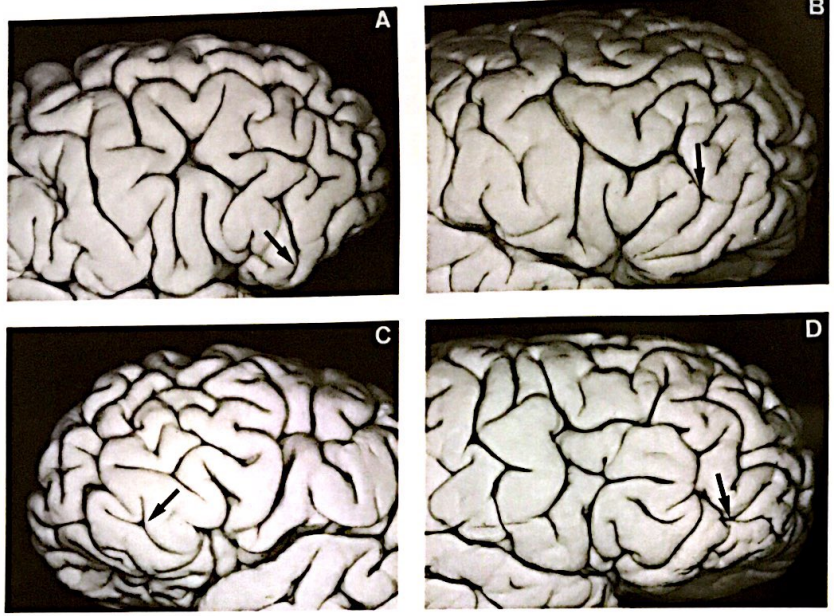


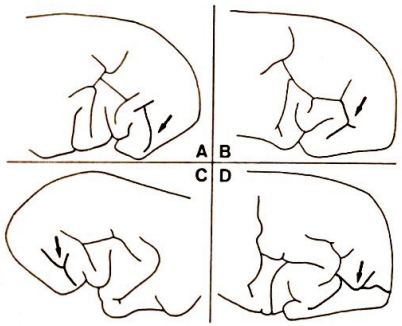


Figure 8.**17**
Inferior frontal sulcus: anterior end
(incidence rates in %)

I. Shape
   1. Straight (A)
      Right – 20%; left – 16%
   2. Y or T-shape (B)
      Right – 80%; left – 84%

II. Connections
   1. With the fronto-orbital sulcus (C)
      Right – 20%; left – 16%
   2. With the frontomarginal sulcus (D)
      Right – 4%; left – 4%

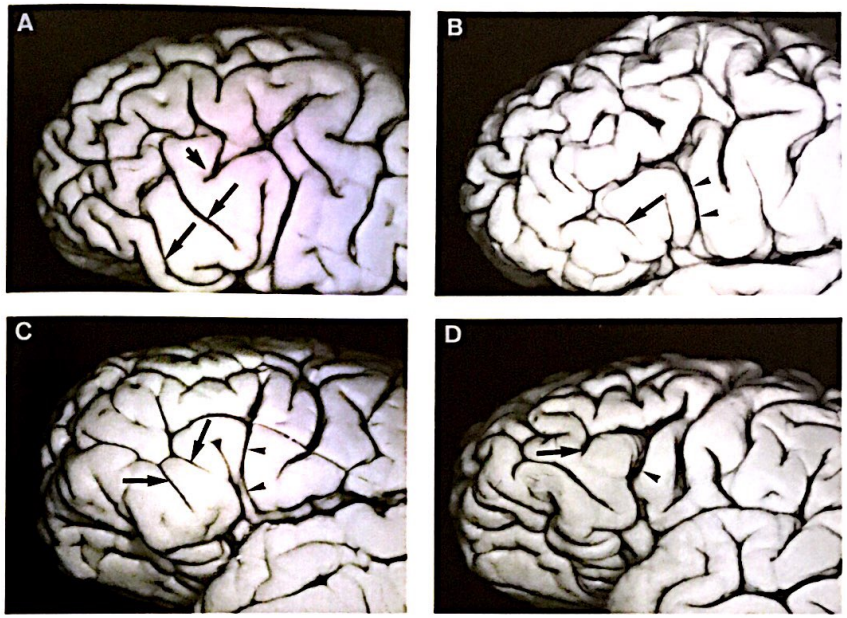


Figure 8.**18**
Inferior frontal sulcus: side branches and connections
(incidence rates in %)

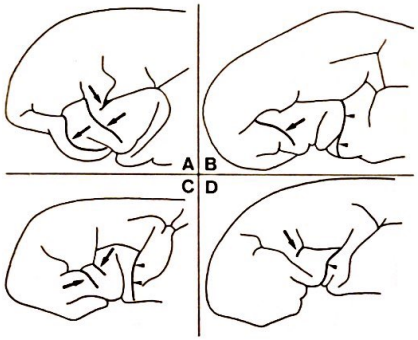
I. Side branches
   1. Upward side branches

Number	*Right*	*Left*
1	4%	12%
2	64%	28%
3	24%	44%
4	4%	16%
5	4%	0%

   2. Downward side branches (A–D)

Number	*Right*	*Left*
1(A)	24%	8%
2(B,D)	64%	76%
3(C)	12%	16%

II. Connections with side branches of the Sylvian fissure
   1. With the ascending ramus (D, single arrowhead)
      Right – 16%; left – 16%
   2. With the horizontal ramus
      Right – 0%; left – 4%
   3. With the diagonal sulcus (B,C, double arrowheads)
      Right – 12%; left – 24%



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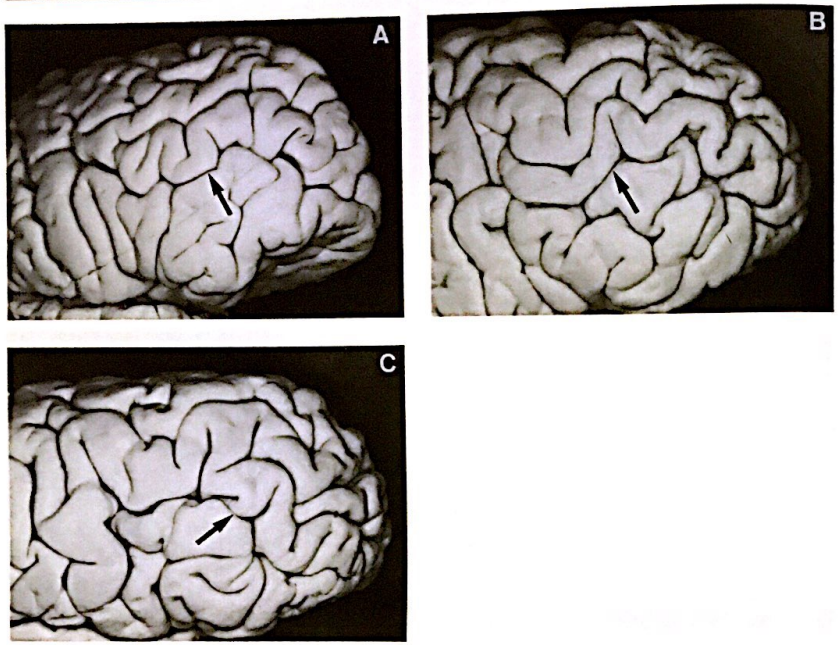


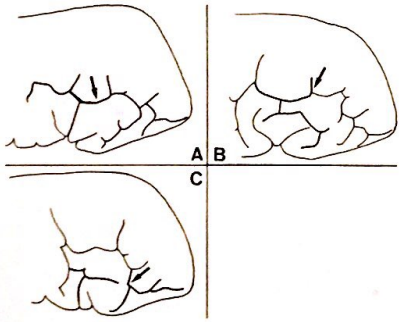


Figure 8.**19**
Inferior frontal sulcus: connections
(continued) (incidence rates in %)

III. Connection with the intermediate frontal sulcus
1. Inferior frontal sulcus to intermediate frontal sulcus (A,B)
Right – 20%; left – 24%
2. Intermediate frontal sulcus to inferior frontal sulcus (C)
Right – 4%; left – 0%

IV. Connection with the superior frontal sulcus (see Fig. 8.**13**)

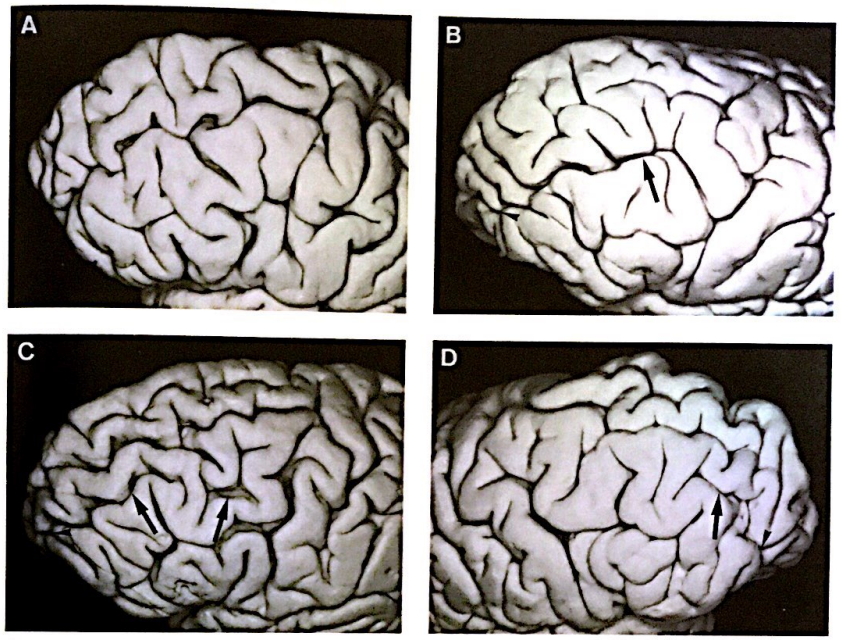
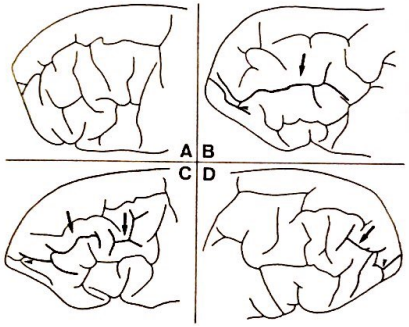


Figure 8.**20**
Intermediate frontal sulcus: patterns and anterior end
(incidence rates in %)

I. No horizontally-oriented sulcus present (A)
Right – 12%; left – 16%

II. Relative lengths and patterns
1. Long (B,C)
a Continuous sulcus (B)
Right – 0%; left – 8%
b Interrupted to two segments (C)
Right – 32%; left – 16%
c Interrupted to three segments
Right – 4%; left – 8%
2. Medium length (D)
a Continuous sulcus (D)
Right – 20%; left – 8%
b Interrupted to two segments
Right – 20%; left – 16%
c Interrupted to three segments
Right – 0%; left – 8%
3. Short
Right – 12%; left – 20%



III. Anterior end
1. Connection with the frontomarginal sulcus (B–D, arrowheads)
Right – 56%; left – 24%
2. Connection with the fronto-orbital sulcus
Right – 0%; left – 4%

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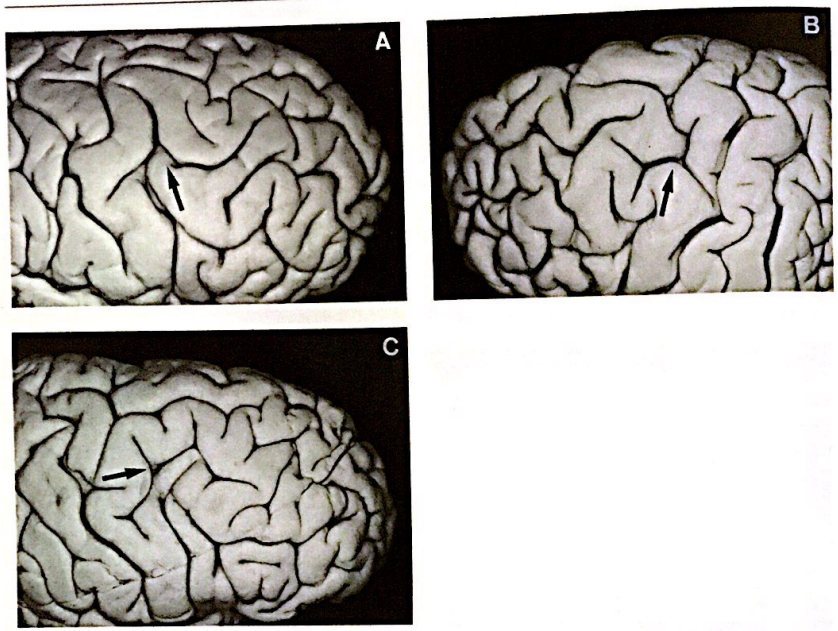


Figure 8.**21**
Intermediate frontal sulcus: posterior end
(incidence rates in %)

Connection with the precentral sulcus

1. With the inferior precentral sulcus (A)
   Right – 20%; left – 28%
2. With the superior precentral sulcus (B)
   Right – 4%; left – 12%
3. With the intermediate precentral sulcus (C)
   Right – 4%; left – 4%

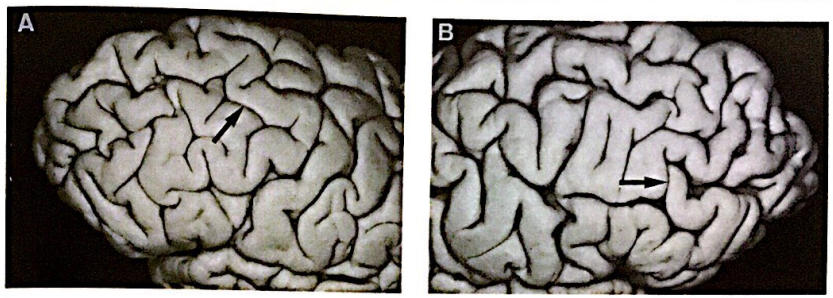
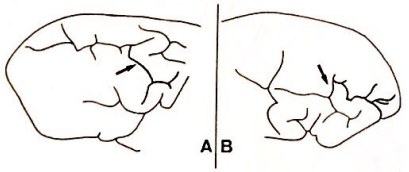


Figure 8.**22**
Intermediate frontal sulcus: connections
(incidence rates in %)

I. Superior frontal sulcus to intermediate frontal sulcus (A)
   Right – 20%; left – 32%
II. Inferior frontal sulcus to intermediate frontal sulcus (B)
   Right – 16%; left – 8%



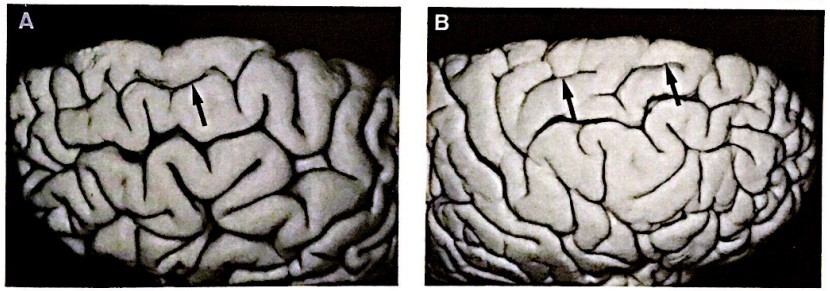
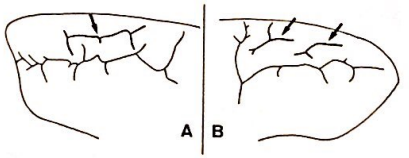


Figure 8.**23**
Medial frontal sulcus: patterns
(incidence rates in %)



I. Horizontally-oriented sulci over the superior frontal gyrus (A,B)

Number	*Right*	*Left*
0	28%	36%
1(A)	44%	20%
2(B)	20%	16%
3	8%	20%
4	0%	8%

II. Sulci crossing the superior margin of the frontal lobe

Number	*Right*	*Left*
3	16%	4%
4	24%	8%
5	52%	36%
6	0%	32%
7	4%	20%
8	4%	0%

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Chapter 9
Parietal and Occipital Lobes: Lateral Surface

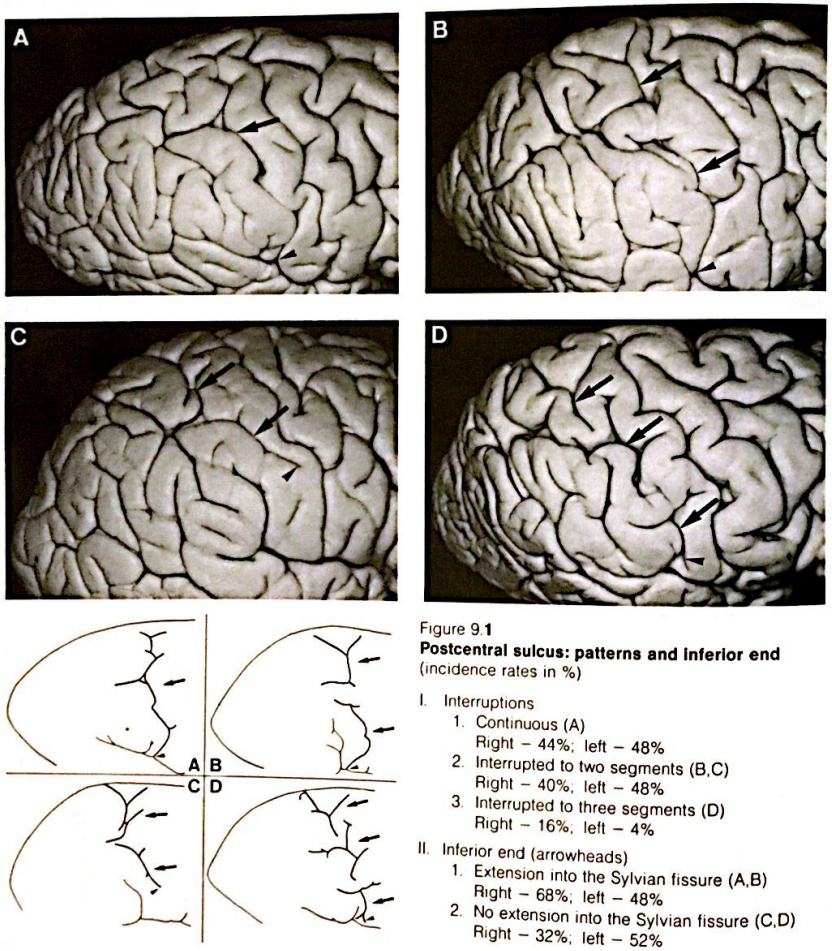


Figure 9.1
Postcentral sulcus: patterns and inferior end
(incidence rates in %)

I. Interruptions
   1. Continuous (A)
      Right – 44%; left – 48%
   2. Interrupted to two segments (B,C)
      Right – 40%; left – 48%
   3. Interrupted to three segments (D)
      Right – 16%; left – 4%

II. Inferior end (arrowheads)
   1. Extension into the Sylvian fissure (A,B)
      Right – 68%; left – 48%
   2. No extension into the Sylvian fissure (C,D)
      Right – 32%; left – 52%

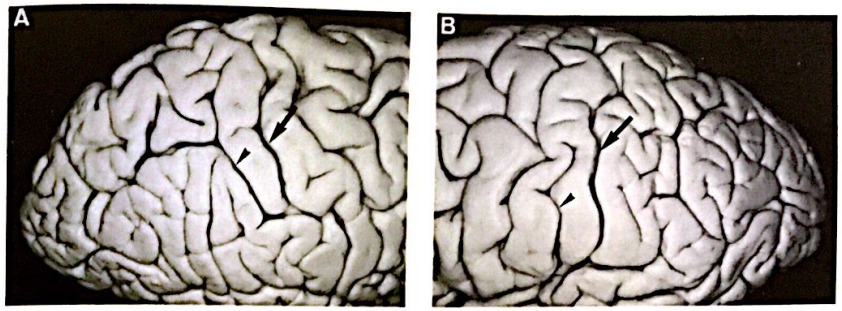
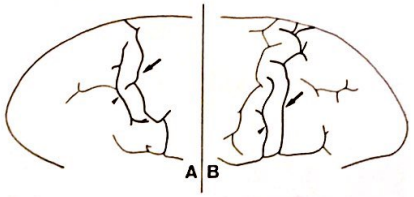


Figure 9.2
Postcentral sulcus: patterns
(incidence rates in %)

Double Parallel Pattern
   1. With the intraparietal sulcus (A)
      Right – 8%; left – 16%
   2. With the posterior subcentral sulcus (B)
      Right – 0%; left – 4%



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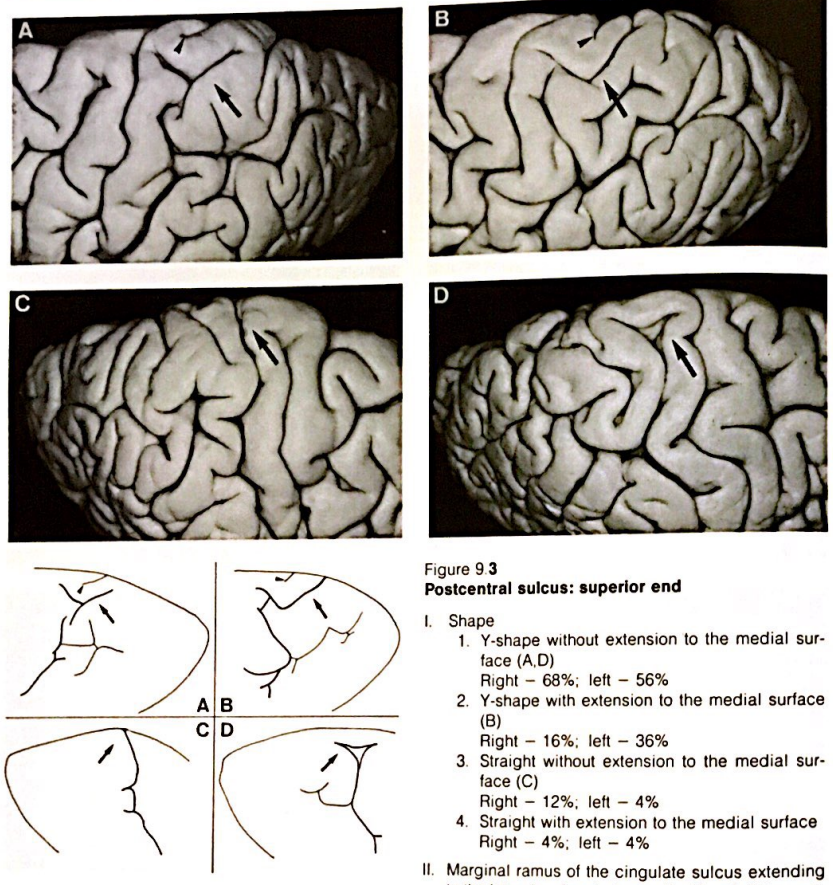

Figure 9.3
Postcentral sulcus: superior end

I. Shape
   1. Y-shape without extension to the medial surface (A,D)
      Right – 68%; left – 56%
   2. Y-shape with extension to the medial surface (B)
      Right – 16%; left – 36%
   3. Straight without extension to the medial surface (C)
      Right – 12%; left – 4%
   4. Straight with extension to the medial surface
      Right – 4%; left – 4%

II. Marginal ramus of the cingulate sulcus extending to the lateral surface between the Y end of the postcentral sulcus (A,B, arrowheads)
   Right – 72%; left – 88%

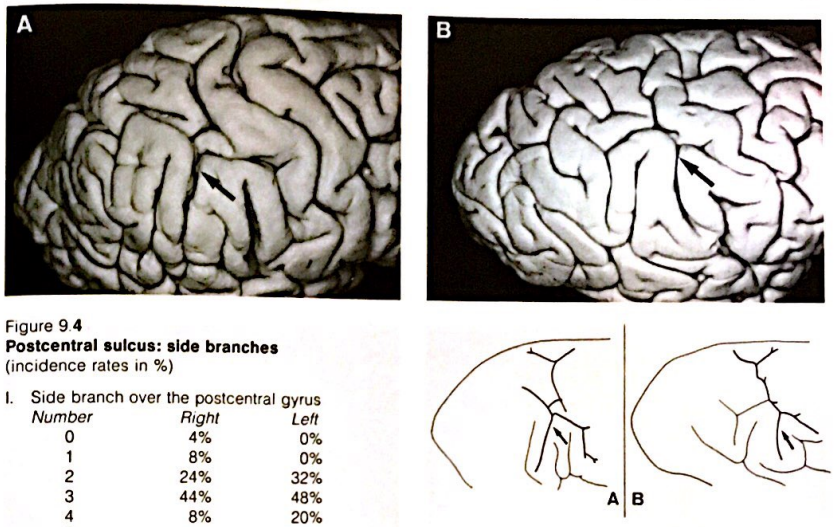

Figure 9.4
Postcentral sulcus: side branches
(incidence rates in %)

I. Side branch over the postcentral gyrus

Number	*Right*	*Left*
0	4%	0%
1	8%	0%
2	24%	32%
3	44%	48%
4	8%	20%
5	12%	0%

II. Side branch over the superior parietal lobule

Number	*Right*	*Left*
0	16%	32%
1	64%	48%
2	20%	20%

III. Side branch over the inferior parietal lobule

Number	*Right*	*Left*
0	28%	80%
1	60%	16%
2	12%	4%

IV. Long side branch as the primary intermediate sulcus (A,B)
   Right – 16%; left – 0%

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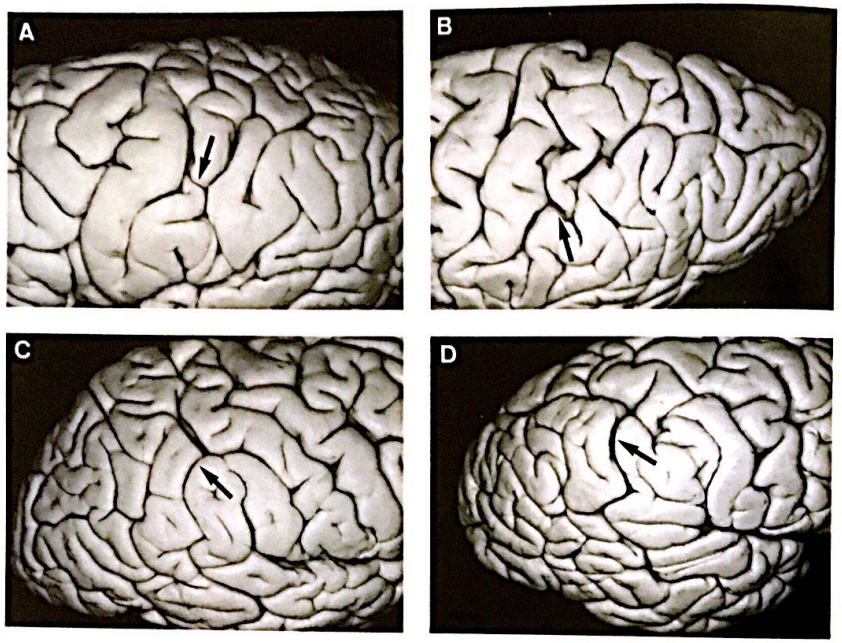


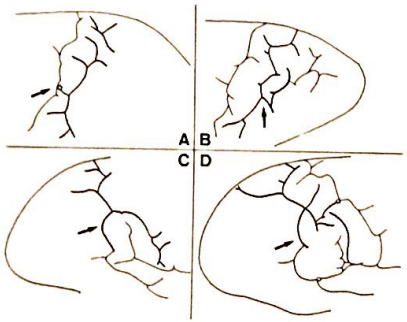


Figure 9.5
Postcentral sulcus: connections
(incidence rates in %)

1. With the central sulcus (A)
   Right – 8%; left – 8%
2. With the intraparietal sulcus (B)
   Right – 64%; left – 72%
3. With the superior temporal sulcus (C,D)
   Right – 8%; left - 0%

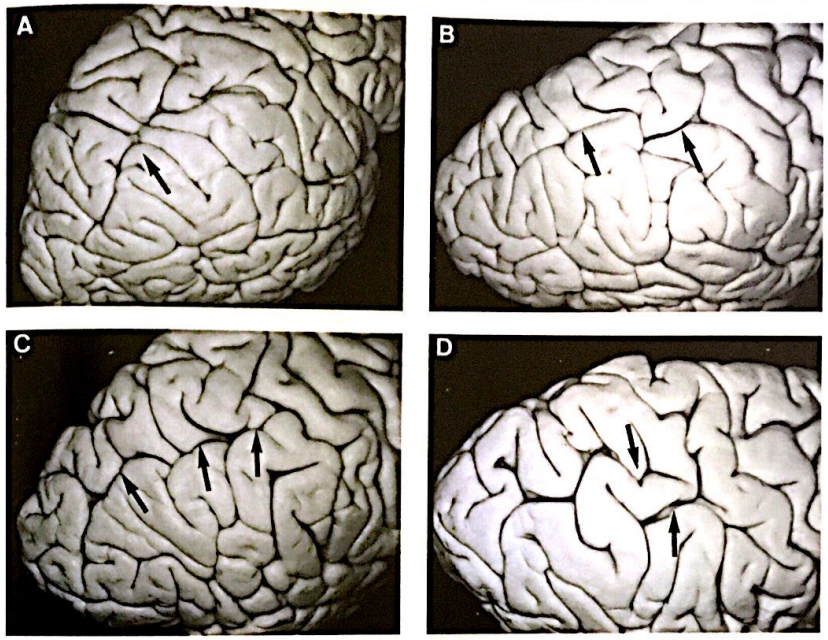
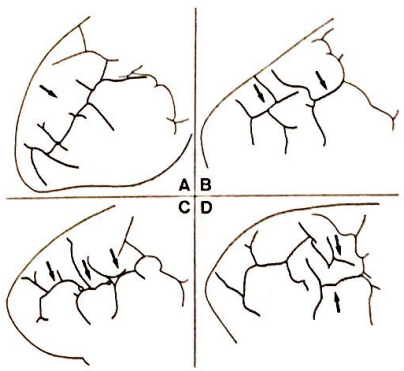


Figure 9.6
Intraparietal sulcus: patterns
(incidence rates in %)

I. Interruption
   1. Continuous (A)
      Right – 28%; left – 72%
   2. Interrupted to two segments (B)
      Right – 68%; left – 28%
   3. Interrupted to three segments (C)
      Right – 4%; left – 0%

II. Double parallel pattern (D)
   Right – 12%; left – 0%



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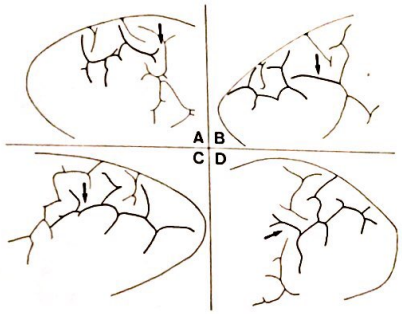
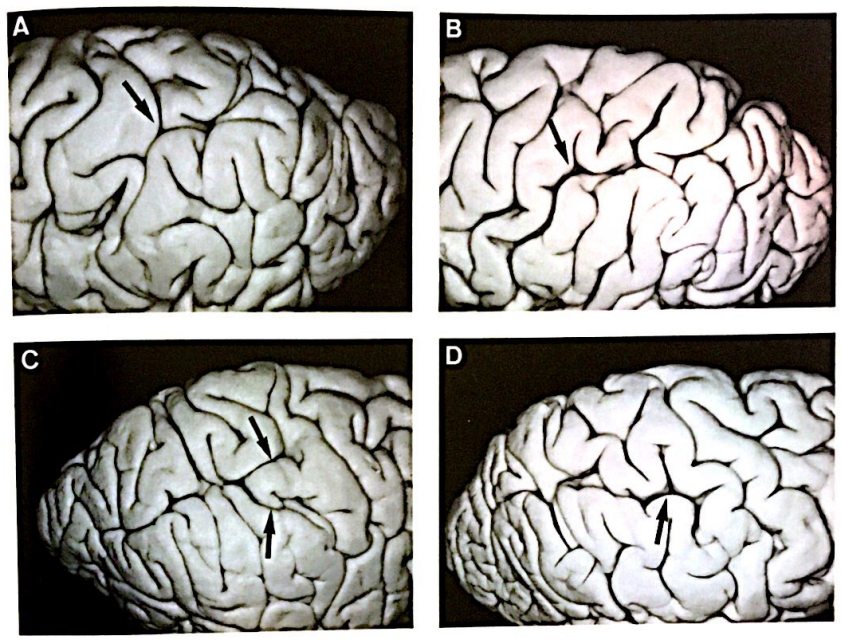


Figure 9.7
Intraparietal sulcus: anterior end
(incidence rates in %)

I. Connection with the postcentral sulcus
   1. No connection (A)
      Right – 36%; left – 28%
   2. Short true connection (B)
      Right – 40%; left – 24%
   3. Long true connection (C)
      Right – 4%; left – 32%
   4. Pseudo-connection
      Right – 20%; left – 16%
   5. Intraparietal sulcus originates between the superior and inferior segments of the postcentral sulcus (D)
      Right – 4%; left – 4%



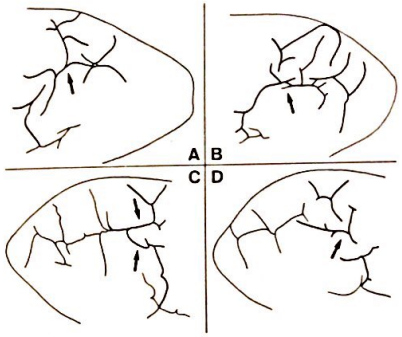


Figure 9.8
Intraparietal sulcus: anterior end
(incidence rates in %)

II. In cases of two interrupted postcentral sulcal segments
   1. Connection to the superior segment of the postcentral sulcus (A)
      Right – 24%; left – 12%
   2. Connection to the inferior segment of the postcentral sulcus (B)
      Right – 0%; left – 24%
   3. Connection to both segments of the postcentral sulcus (C)
      Right – 4%; left – 0%

III. In cases of three interrupted postcentral sulcal segments
   1. Connection to the intermediate segment of the postcentral sulcus (D)
      Right – 8%; left – 0%
   2. Connection to the intermediate and superior segments of the postcentral sulcus
      Right – 4%; left – 0%
   3. Connection to the intermediate and inferior segments of the postcentral sulcus
      Right – 0%; left – 4%

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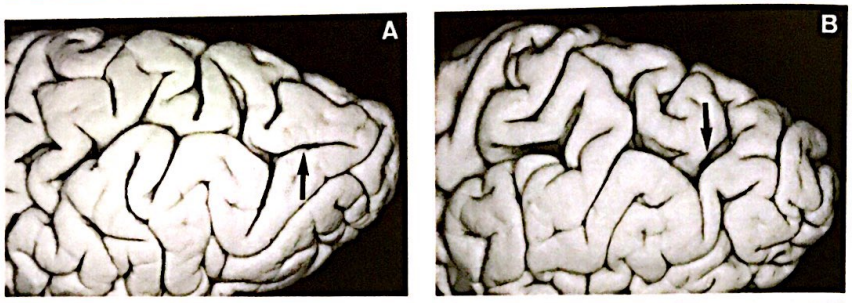


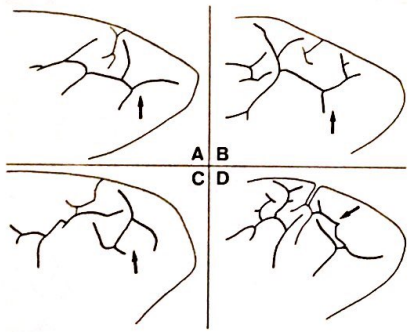


Figure 9.9
Intraparietal sulcus: posterior end and transverse occipital sulcus
(incidence rates in %)

I. Extension into the occipital lobe of the intraparietal sulcus
Right – 100%; left – 96%
No extension case (D)

II. Transverse occipital sulcus
1. As side branch of the intraparietal sulcus (A)
Right – 24%; left – 28%
2. As T end of the intraparietal sulcus (B)
Right – 72%; left – 60%
3. Separate from the intraparietal sulcus (C)
Right – 4%; left – 12%

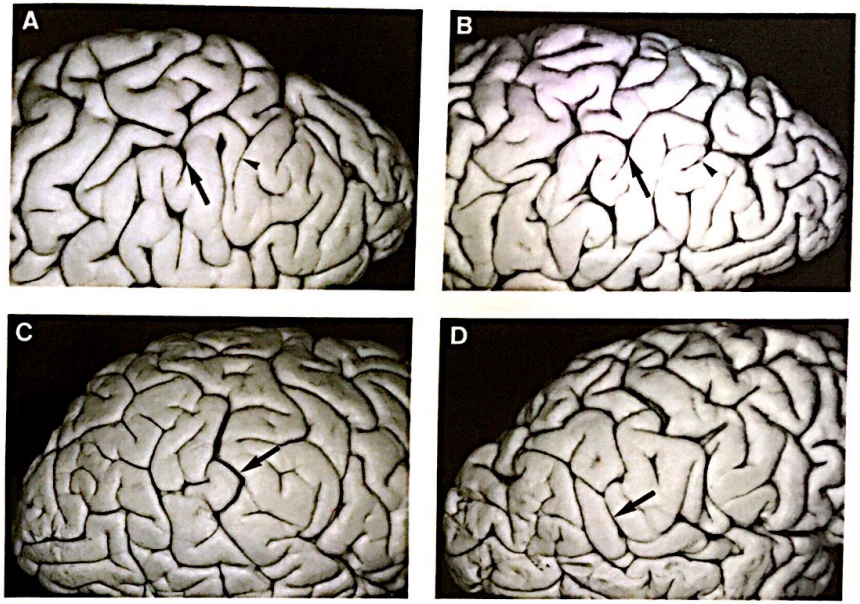


Figure 9.10
Intraparietal sulcus: side branches
(incidence rates in %)

I. Downward-projecting side branches
1. Total number present in parietal lobe

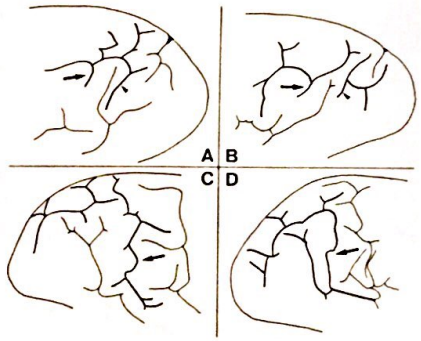
Number	*Right*	*Left*
1	32%	36%
2	56%	52%
3	12%	12%

2. Primary intermediate sulcus (A,B, arrows)
Right – 24%; left – 80%
3. Secondary intermediate sulcus (A,B, arrowheads)
Right – 64%; left – 72%
4. Both primary and secondary intermediate sulci (A,B)
Right – 16%; left – 56%

II. Long primary intermediate sulcus (C,D)
Right – 8%; left – 0%

III. Upward-projecting side branches
1. Total number present in the parietal lobe

Number	*Right*	*Left*
1	16%	12%
2	72%	48%
3	12%	32%
4	0%	8%



2. Upward side branches crossing the superior margin of the hemisphere
Right – 12%; left – 16%

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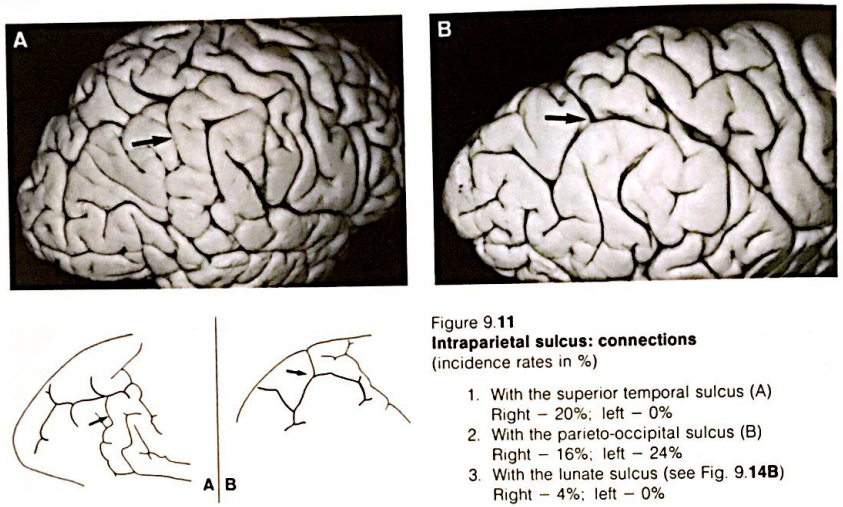


Figure 9.**11**
Intraparietal sulcus: connections
(incidence rates in %)

1. With the superior temporal sulcus (A)
   Right – 20%; left – 0%
2. With the parieto-occipital sulcus (B)
   Right – 16%; left – 24%
3. With the lunate sulcus (see Fig. 9.**14B**)
   Right – 4%; left – 0%

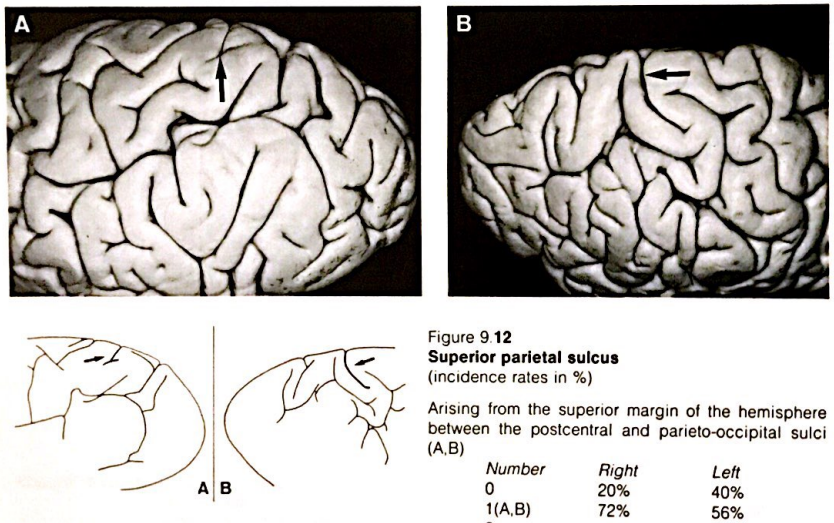


Figure 9.**12**
Superior parietal sulcus
(incidence rates in %)

Arising from the superior margin of the hemisphere between the postcentral and parieto-occipital sulci (A,B)

Number	*Right*	*Left*
0	20%	40%
1(A,B)	72%	56%
2	8%	4%

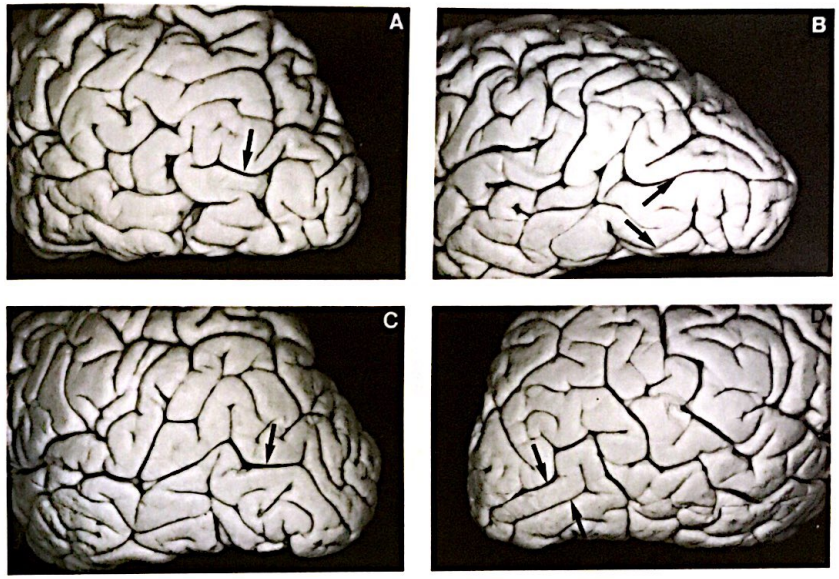


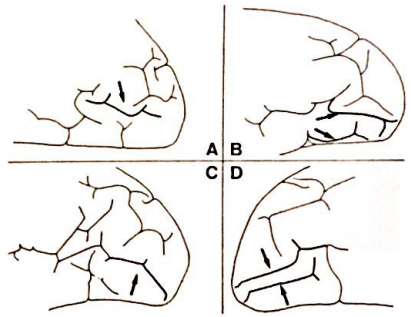
Figure 9.**13**
Lateral occipital sulcus and transverse occipital sulcus
(incidence rates in %)

I. Lateral (or inferior) occipital sulcus
   1. Number of lateral occipital sulci (A-D)

Number	*Right*	*Left*
0	4%	4%
1(A,C)	60%	52%
2(B,D)	36%	40%
3	0%	4%

   2. Connections
      a With the inferior temporal sulcus (B)
      Right – 24%; left – 60%
      b With the superior temporal sulcus (C)
      Right – 4%; left – 12%
      c With the occipitotemporal sulcus (D)
      Right – 8%; left – 4%
      d With the intraparietal sulcus
      Right – 8%; left – 0%

II. Transverse occipital sulcus
   1. Relationship with the intraparietal sulcus (see Fig. 9.**9**)
   2. Crossing of the superior margin of the hemisphere
      Right – 12%; left – 0%
   3. Connections
      a With the inferior temporal sulcus
      Right – 4%; left – 0%
      b With the lateral occipital sulcus
      Right – 4%; left – 4%



      c With the occipitotemporal sulcus
      Right – 4%; left – 0%
      d With the parieto-occipital sulcus
      Right – 0%; left – 4%

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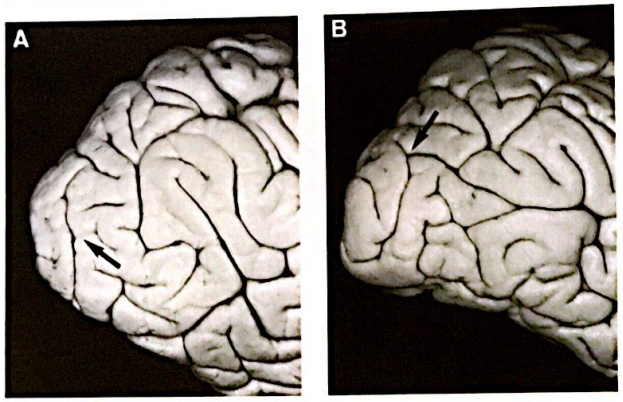


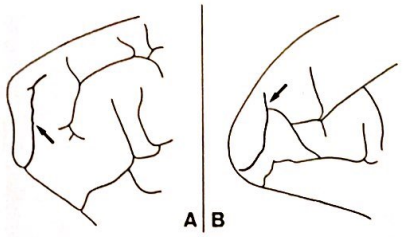


Figure 9.**14**
Lunate sulcus
(incidence rates in %)

I. No lunate sulcus present
   Right – 40%; left – 36%

II. Connections
   1. No connection (A)
      Right – 48%; left – 32%
   2. With the inferior temporal sulcus
      Right – 4%; left – 20%
   3. With the lateral occipital sulcus
      Right – 4%; left – 12%
   4. With the intraparietal sulcus (B)
      Right – 4%; left – 0%

Chapter 10
Temporal Lobe: Lateral Surface

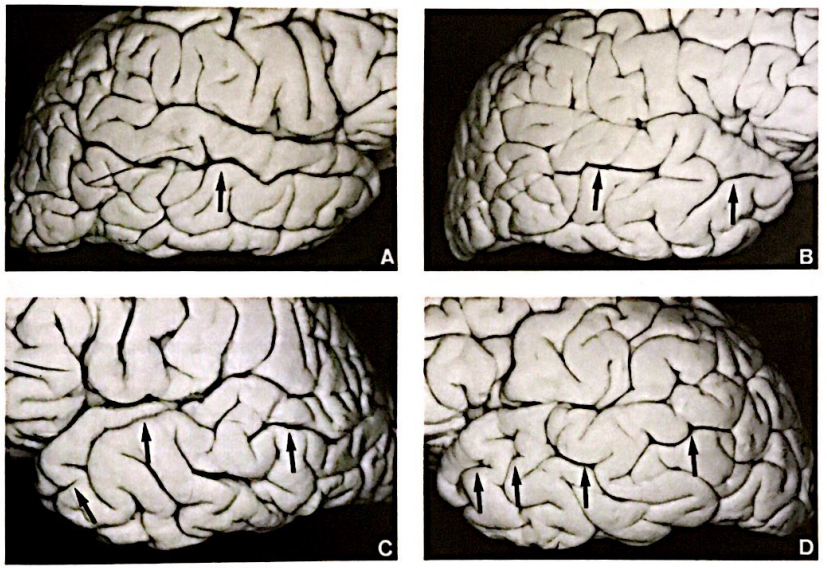
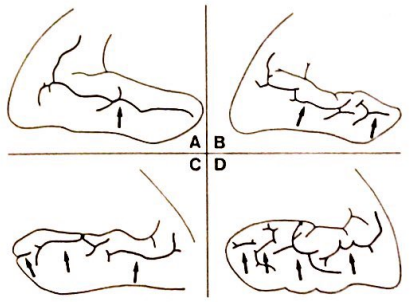


Figure 10.**1**
Superior temporal sulcus: patterns
(incidence rates in %)

I. Interruptions
   1. Continuous (A)
      Right – 36%; left – 28%
   2. Interrupted to two segments (B)
      Right – 48%; left – 32%
   3. Interrupted to three segments (C)
      Right – 16%; left – 16%
   4. Interrupted to four segments (D)
      Right – 0%; left - 24%

II. Most consistent interruption point: below the inferior end of the central sulcus
      Right – 20%; left – 56%



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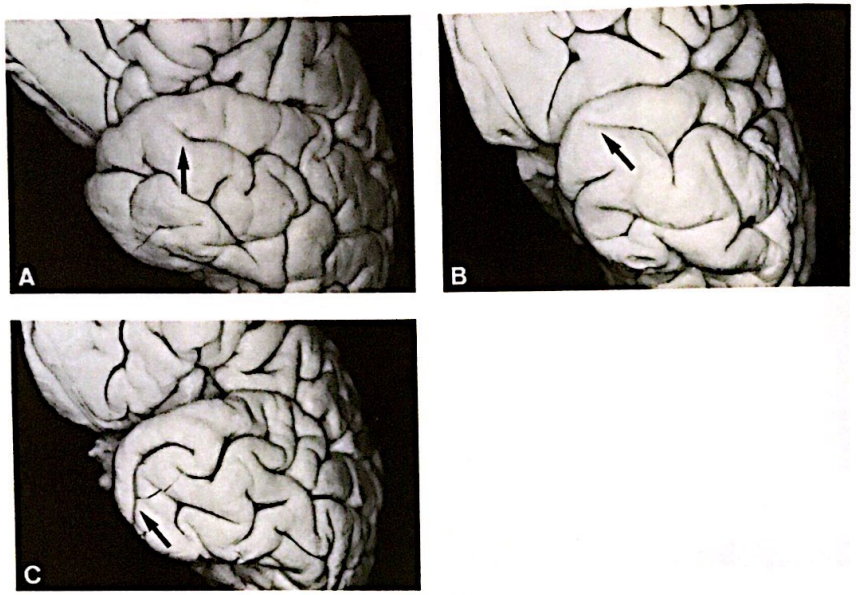


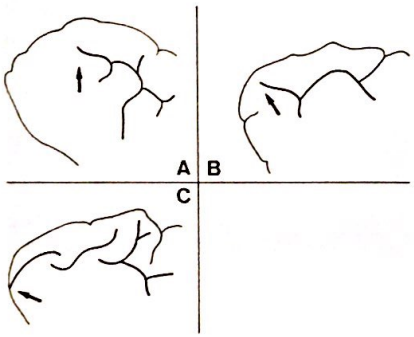


Figure 10.2
Superior temporal sulcus: anterior end
(incidence rates in %)

I. Anterior end
1. Lateral to the temporal pole (A)
Right – 12%; left – 16%
2. At the temporal pole (B)
Right – 48%; left – 28%
3. Medial to the temporal pole (C)
Right – 40%; left – 40%
4. Far posterior to the temporal pole
Right – 0%; left – 16%

Note: no superior temporal sulcus was found to extend over the temporal tip in type no. 4.

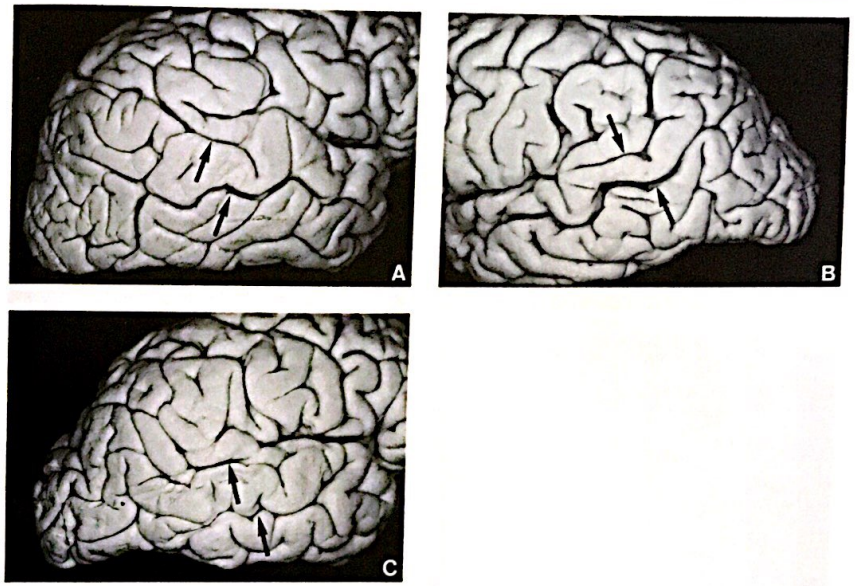
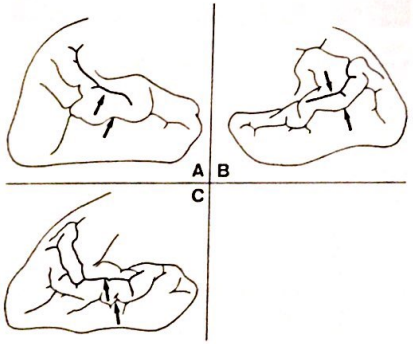


Figure 10.3
Superior temporal sulcus: posterior end
(incidence rates in %)

Double parallel type
1. Incidence
Right – 12%; left – 4%
2. Free superior segment (A)
3. Superior segment connected to the intraparietal sulcus (B,C)



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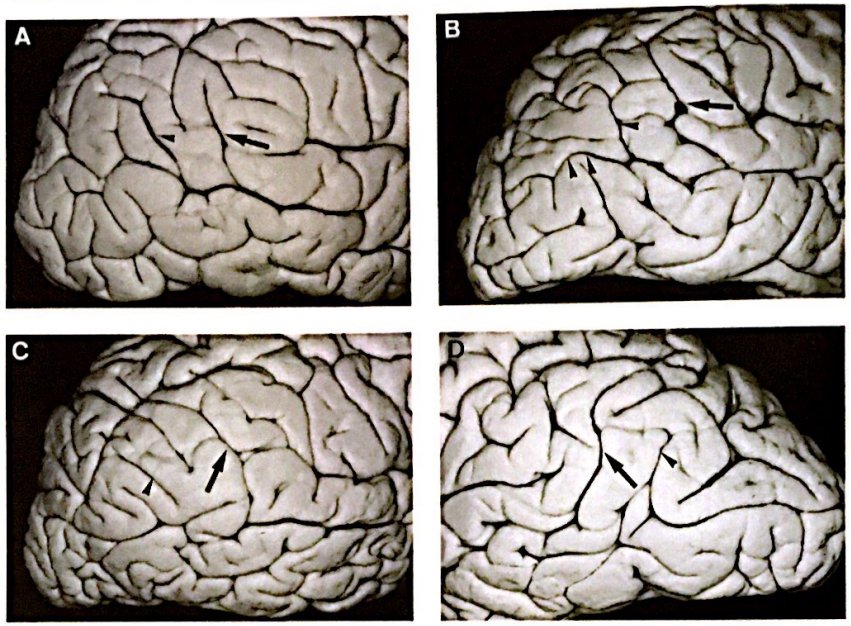
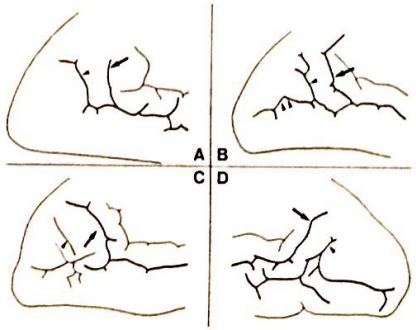


Figure 10.4
Superior temporal sulcus: posterior end
(incidence rates in %)

I. Extension into the occipital lobe (B, double arrowheads)
   Right – 16%; left – 16%
II. Extension into the parietal lobe
   1. Single ending to the angular sulcus (C,D, single arrows)
      Right – 56%; left – 48%
   2. Single ending to the anterior occipital sulcus
      Right – 0%; left – 4%
   3. Double ending to the angular and anterior occipital sulci (A)
      Right – 28%; left – 44%
III. Angular sulcus
   1. As the posterior ending of the superior temporal sulcus (A–D)
      Right – 84%; left – 92%
   2. As the superior segment of a double parallel superior temporal sulcus (C)
      Right – 16%; left – 4%
   3. As a free sulcus
      Right – 0%; left – 4%
IV. Anterior occipital sulcus (A–D, single arrowheads)
   1. As the posterior ending of the superior temporal sulcus (A,B)
      Right – 28%; left – 48%



   2. As the superior segment of a double parallel superior temporal sulcus (see Fig. 10.**3C**)
      Right – 12%; left – 4%
   3. As the posterior ending of the inferior temporal sulcus (D)
      Right – 48%; left – 32%
   4. As a free sulcus (C)
      Right – 8%; left – 12%
   5. No anterior occipital sulcus present
      Right – 0%; left – 4%

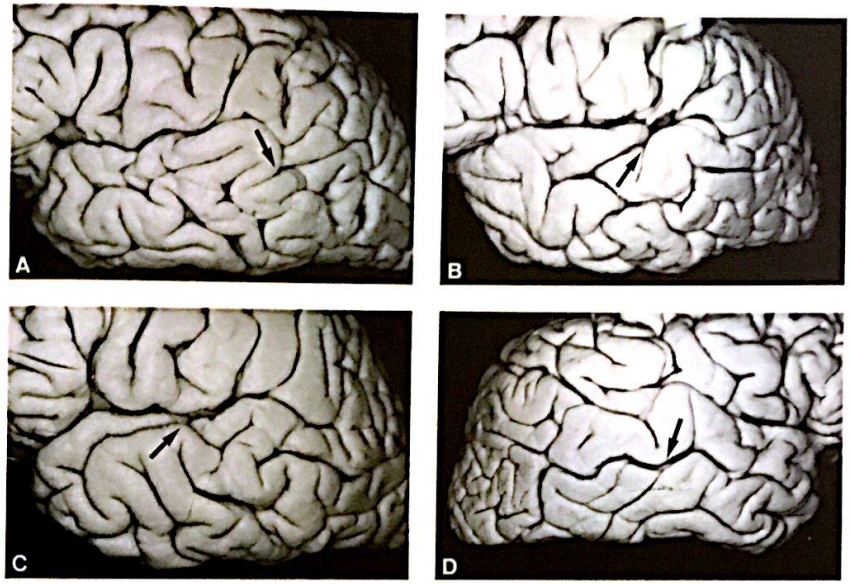
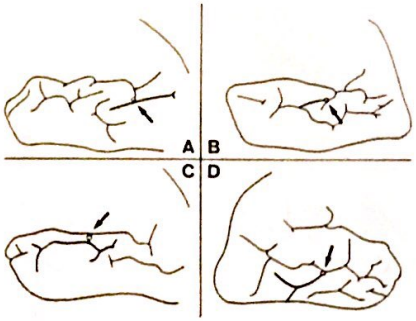


Figure 10.5
Superior temporal sulcus: connections
(incidence rates in %)

I. Connections with the Sylvian fissure
   1. With the descending terminal ramus (A)
      Right – 4%; left – 16%
   2. With the transverse temporal sulcus (B)
      Right – 0%; left – 12%
   3. With the middle segment of the posterior ramus (C)
      Right – 0%; left – 12%
II. Connection with the inferior temporal sulcus (D)

Number	*Right*	*Left*
1	52%	32%
2	16%	8%
3	0%	4%



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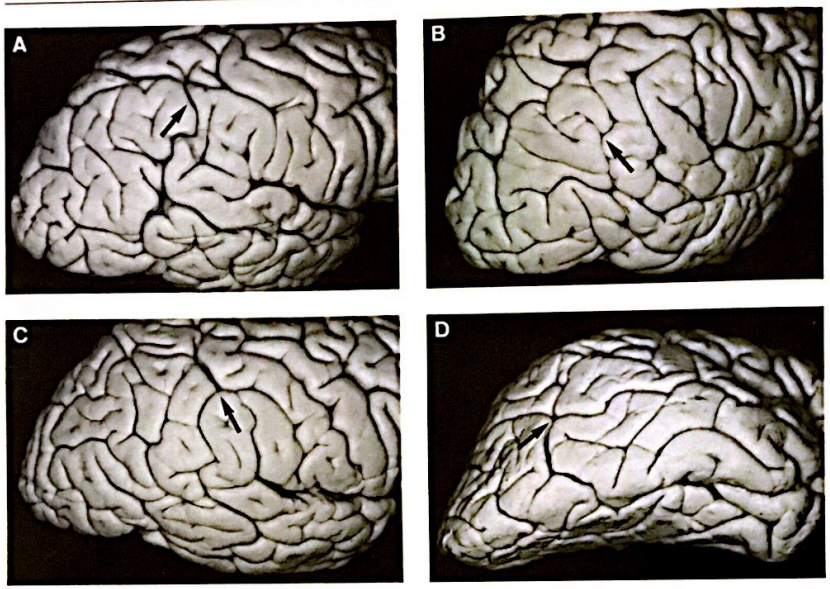


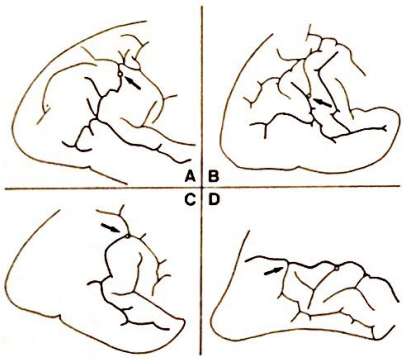


Figure 10.6
Superior temporal sulcus: connections
(incidence rates in %)

III. Connections with the intraparietal sulcus
1. Via the angular sulcus (A)
Right – 20%; left – 0%
2. Via the anterior occipital sulcus (B)
Right – 4%; left – 0%

IV. Connection with the postcentral sulcus (C)
Right – 8%; left - 0%

V. Connection with the occipitotemporal sulcus (D)
Right – 20%; left – 4%

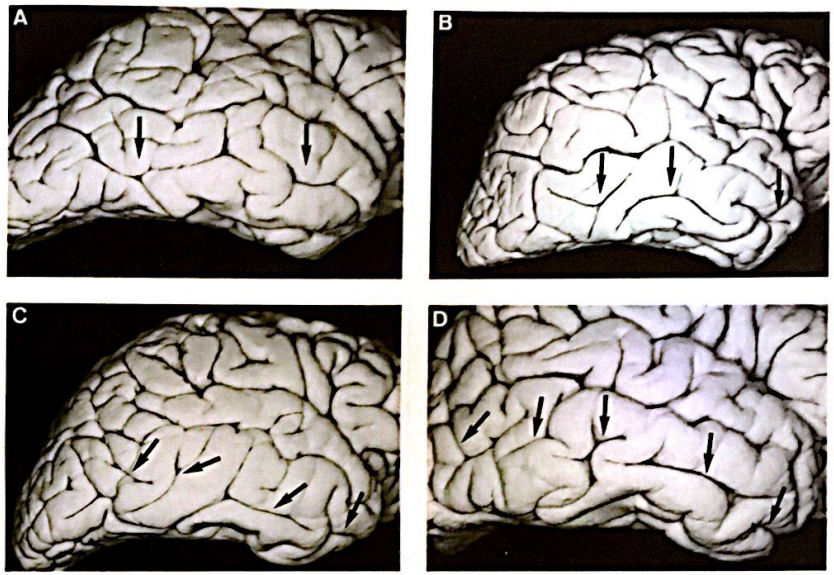
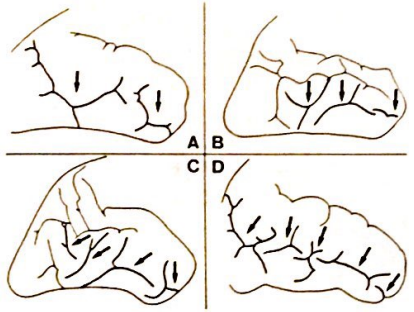


Figure 10.7
Inferior temporal sulcus: patterns
(incidence rates in %)

Interruptions
1. Interrupted to two segments (A)
Right – 8%; left – 0%
2. Interrupted to three segments (B)
Right – 28%; left – 24%
3. Interrupted to four segments (C)
Right – 40%; left – 44%
4. Interrupted to five segments (D)
Right – 16%; left – 32%
5. Interrupted to six segments
Right – 4%; left – 0%



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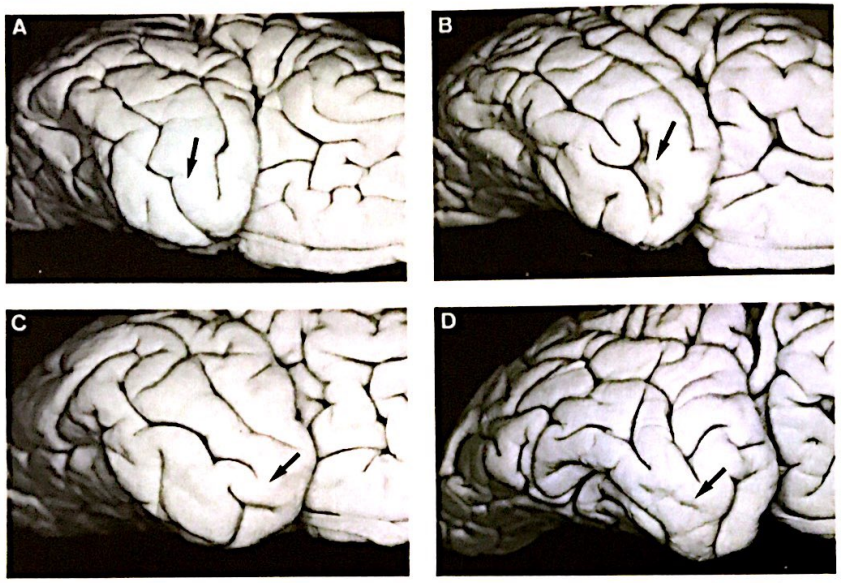


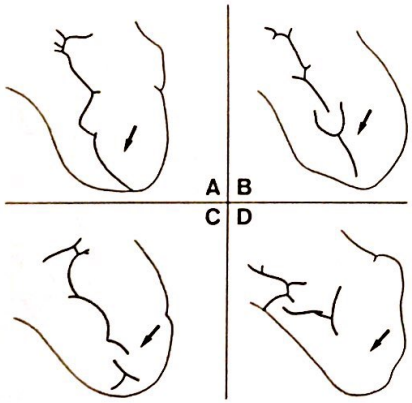


Figure 10.**8**
Inferior temporal sulcus: anterior end
(incidence rates in %)

Extension over the temporal tip

1. Extended sulcus from the lateral surface (A)
   Right – 40%; left – 28%
2. Separate segment (B)
   Right – 16%; left – 52%
3. Both extended sulcus and separate segment present (C)
   Right – 40%; left – 16%
4. Inferior temporal sulcus not present over the temporal tip (D)
   Right – 4%; left – 4%

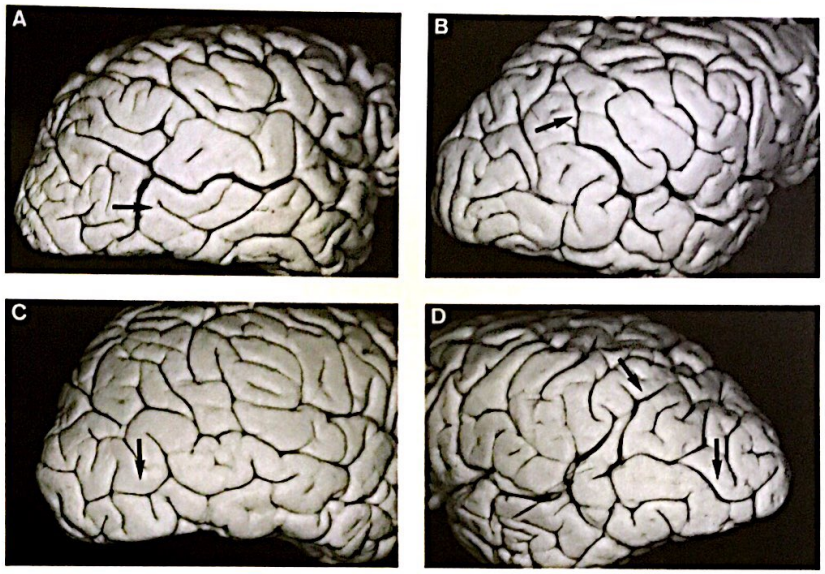
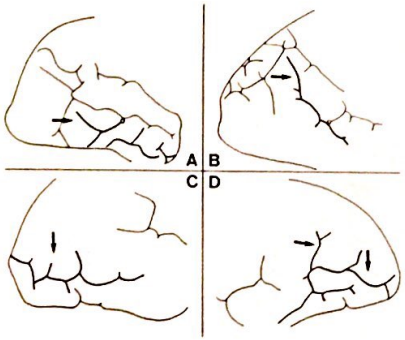


Figure 10.**9**
Inferior temporal sulcus: posterior end
(incidence rates in %)

Extensions

1. No extensions to the parietal or occipital lobes (A)
   Right – 32%; left – 16%
2. Extension into the parietal lobe (B)
   Right – 36%; left – 0%
3. Extension into the occipital lobe (C)
   Right – 20%; left – 48%
4. Extension into both the parietal and occipital lobes (D)
   Right – 12%; left – 36%

Note: in the type 1 cases, the posterior end terminated near the preoccipital incisura. In the type 3 cases, the occipital extension typically became the lateral occipital sulcus (see also Fig. 9.**13B**).



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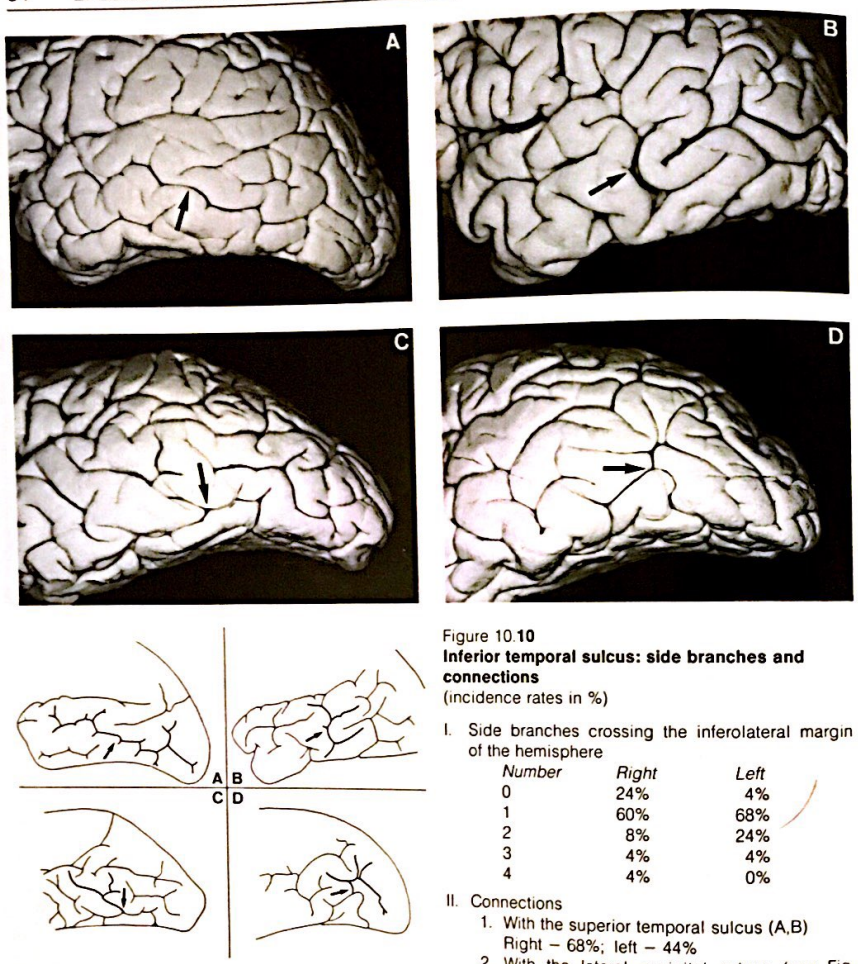

Figure 10.**10**
Inferior temporal sulcus: side branches and connections
(incidence rates in %)

I. Side branches crossing the inferolateral margin of the hemisphere

Number	*Right*	*Left*
0	24%	4%
1	60%	68%
2	8%	24%
3	4%	4%
4	4%	0%

II. Connections
1. With the superior temporal sulcus (A,B)
Right – 68%; left – 44%
2. With the lateral occipital sulcus (see Fig. 9.**13B**)
3. With the occipitotemporal sulcus anterior to the preoccipital incisura (C)
Right – 24%; left – 20%
4. With the occipitotemporal sulcus at the preoccipital incisura (D)
Right – 8%; left – 40%
5. With the intraparietal sulcus
Right – 12%; left – 4%

3

Sulcal Patterns of the Cerebral Hemispheres: Inferior Surface

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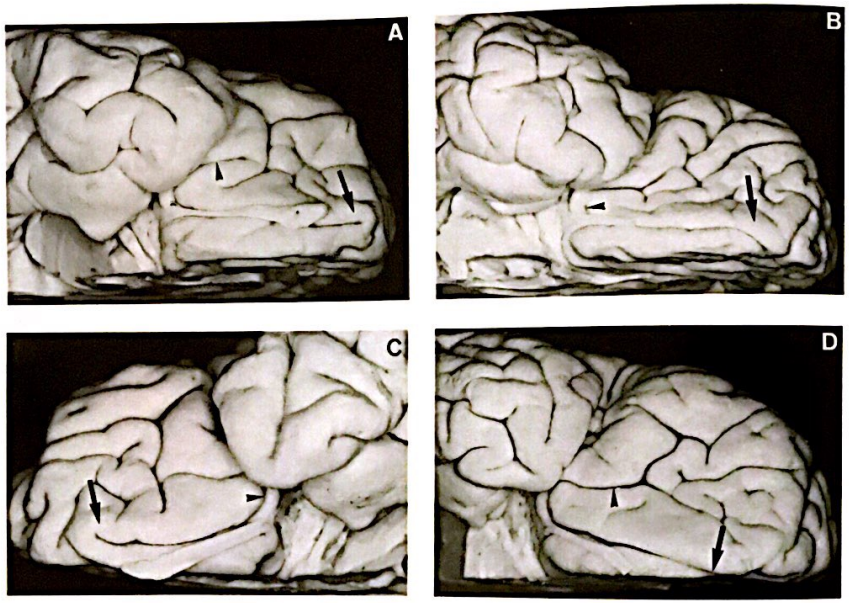
Chapter 11
Frontal Lobe: Inferior Surface



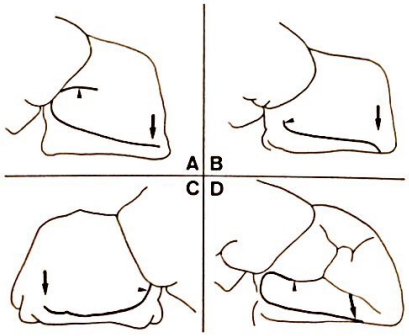


Figure 11.1
Olfactory sulcus: anterior and posterior ends
(incidence rates in %)

I. Anterior end patterns
   1. Straight (A)
      Right – 48%; left – 56%
   2. Medial turn (B)
      Right – 48%; left – 36%
   3. Lateral turn (C)
      Right – 4%; left – 8%
   4. Extension to the medial surface (D)
      Right – 12%; left – 16%

II. Posterior end patterns
   1. No lateral extension (B)
      Right – 52%; left – 28%
   2. Short lateral extension (C)
      Right – 20%; left – 48%
   3. Long lateral extension (A)
      Right – 28%; left – 24%
   4. Connection with the orbital sulcus (D)
      Right – 16%; left – 0%

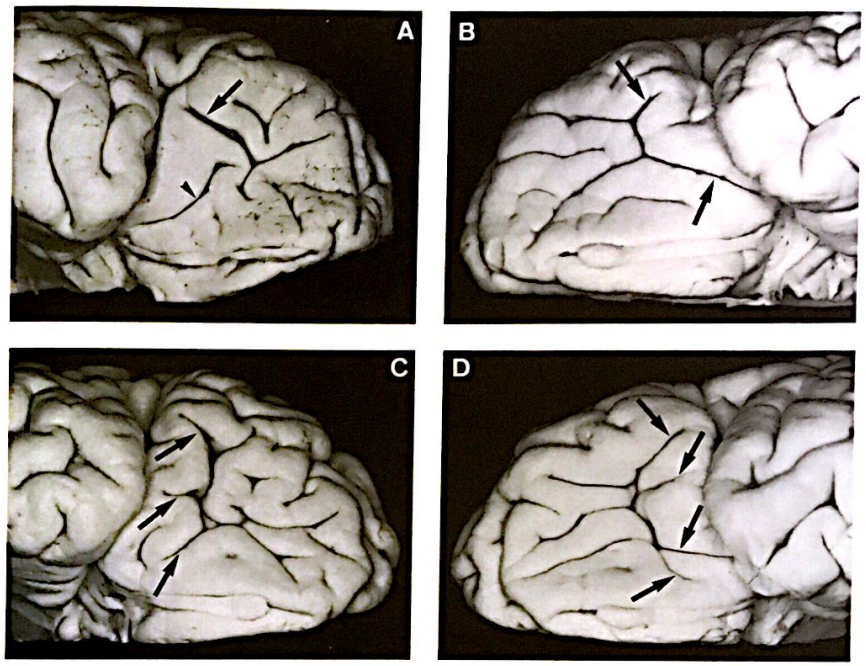


Figure 11.2
Orbital sulci: pattern of the posterior end and transverse orbital sulcus
(incidence rates in %)

I. Patterns
   1. Posteriorly-directed branches (A–D)

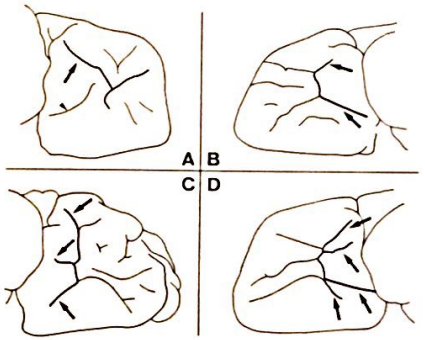
Number	*Right*	*Left*
1(A)	12%	16%
2(B)	68%	68%
3(C)	20%	4%
4(D)	0%	12%

   2. Free sulcus in posterior end (A, arrow head)
      Right – 32%; left – 32%
   3. Total posteriorly-directed sulci (C)

Number	*Right*	*Left*
2	68%	64%
3	32%	24%
4	0%	12%

   4. Typical H-pattern (B)
      Right – 0%; left – 12%

II. Transverse orbital sulcus
   1. Clearly evident
      Right – 88%; left – 88%
   2. Questionably present
      Right – 12%; left – 12%



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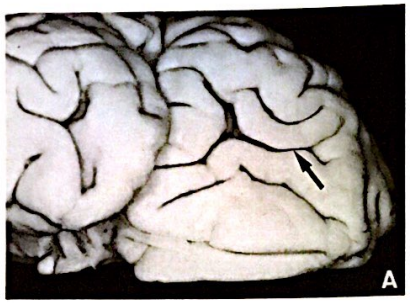
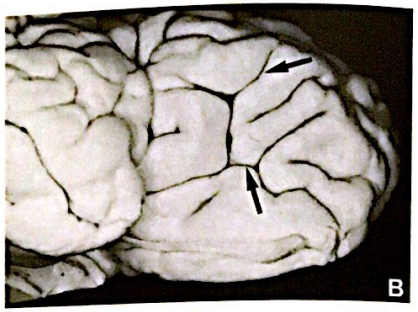
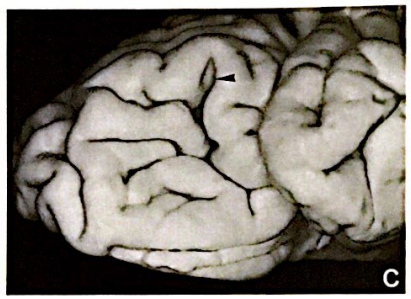






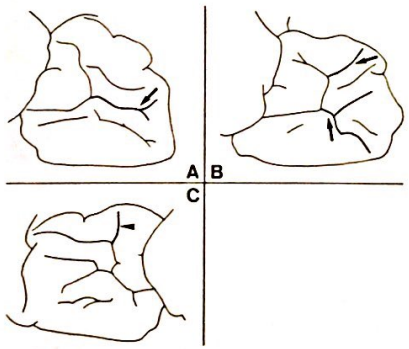


Figure 11.3
Orbital sulci: pattern of the anterior end
(incidence rates in %)

Patterns

1. Anteriorly-directed branches (A–C)

Number	*Right*	*Left*
1(A)	52%	20%
2(B,C)	44%	68%
3	4%	12%

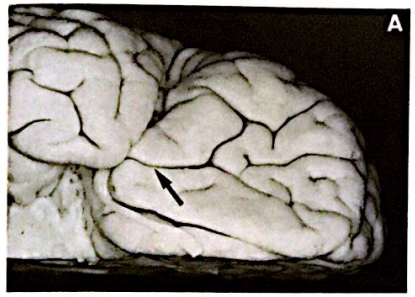
2. Division of the medial branch (B)
   Right – 12%; left – 8%
3. Division of the lateral branch (C)
   Right – 4%; left – 8%
4. Free sulci (A,B)

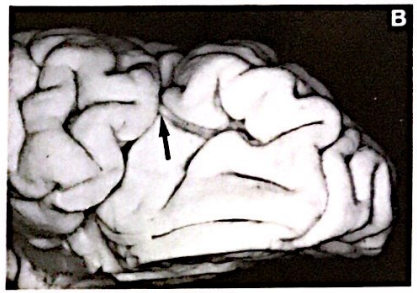
Number	*Right*	*Left*
0	0%	8%
1	32%	48%
2(A,B)	56%	44%
3	12%	0%

5. Total anteriorly-directed sulci

Number	*Right*	*Left*
1	0%	4%
2	8%	12%
3	60%	44%
4	24%	36%
5	8%	4%

6. Laterally-directed sulcus (C, arrow head)
   Right – 32%; left – 16%





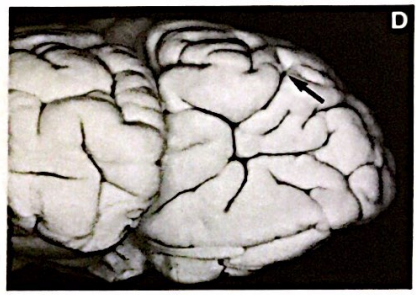
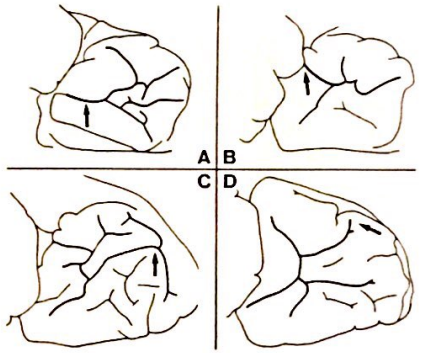


Figure 11.4
Orbital sulci: connections and side branches crossing the orbital margin of the hemisphere
(incidence rates in %)

I. Connections
   1. With the olfactory sulcus (A)
      Right – 6%; left – 0%
   2. With the Sylvian fissure (B)
      Right – 20%; left – 16%
   3. With the frontomarginal sulcus (see Fig. 11.6)
      Right – 0%; left – 16%

II. Side branches crossing the orbital margin
   1. Across the anterior portion of the orbital margin (C)
      Right – 16%; left – 20%
   2. Across the lateral portion of the orbital margin (D)
      Right – 8%; left – 0%



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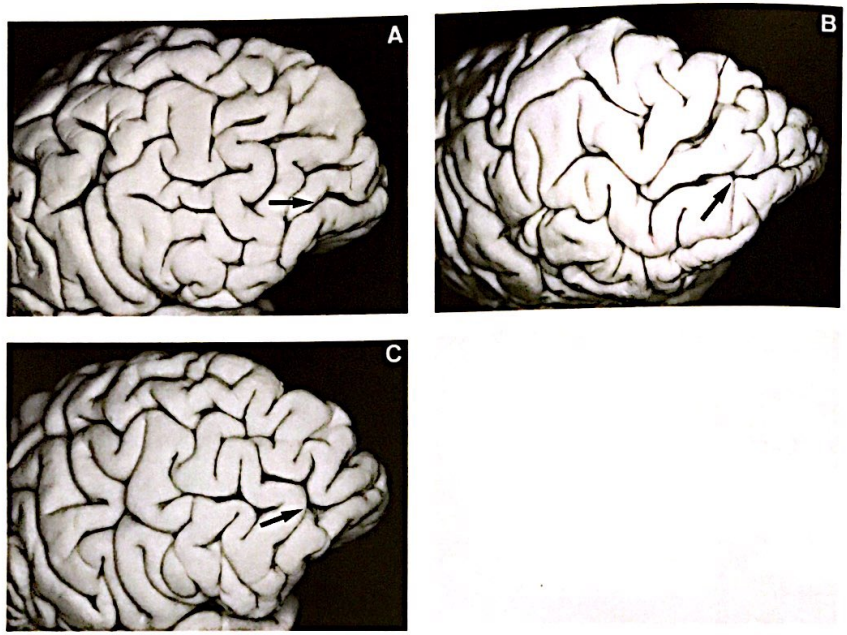


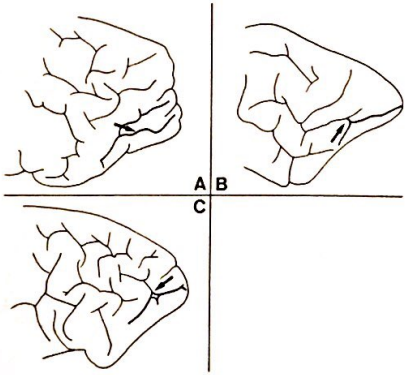


Figure 11.5
Frontomarginal sulcus: patterns and connections
(incidence rates in %)

I. Interruptions
   1. Continuous (A–C)
      Right – 80%; left – 76%
   2. Interrupted to two segments
      Right – 16%; left – 20%
   3. Interrupted to three segments
      Right – 4%; left – 4%

II. Connections with sulci of the lateral surface
   1. No connection (A)
      Right – 24%; left – 32%
   2. With the intermediate frontal sulcus (B)
      Right – 60%; left – 24%
   3. With the superior frontal sulcus (C)
      Right – 16%; left – 44%

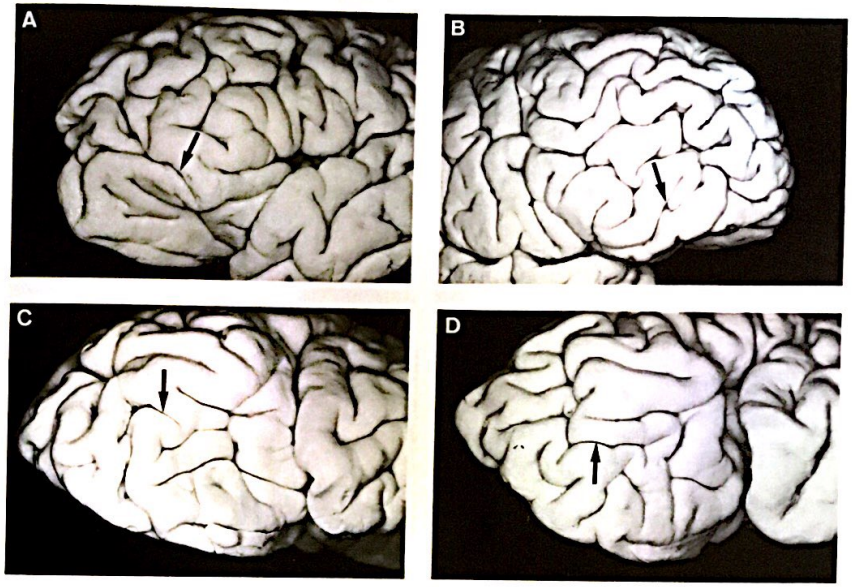
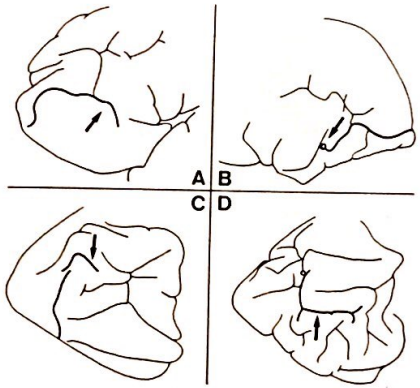


Figure 11.6
Frontomarginal sulcus: relationship to orbital and fronto-orbital sulci
(incidence rates in %)

I. Connection to the fronto-orbital sulcus
   1. Direct continuation (A)
      Right – 12%; left – 4%
   2. Side connection (B)
      Right – 16%; left – 4%

II. Extension to the orbital surface
   1. Without connection to the orbital sulci (C)
      Right – 0%; left – 20%
   2. With connection to the orbital sulci (D)
      Right – 0%; left – 16%



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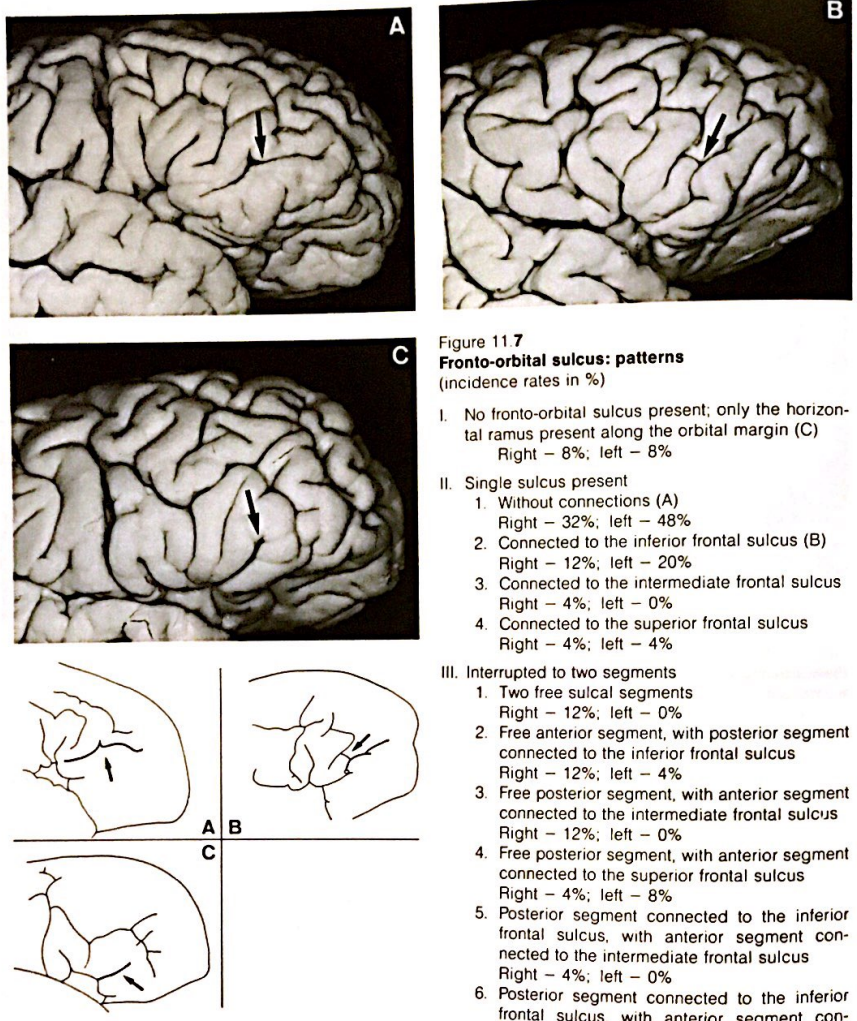


Figure 11.7
Fronto-orbital sulcus: patterns
(incidence rates in %)

I. No fronto-orbital sulcus present; only the horizontal ramus present along the orbital margin (C)
   Right – 8%; left – 8%

II. Single sulcus present
   1. Without connections (A)
      Right – 32%; left – 48%
   2. Connected to the inferior frontal sulcus (B)
      Right – 12%; left – 20%
   3. Connected to the intermediate frontal sulcus
      Right – 4%; left – 0%
   4. Connected to the superior frontal sulcus
      Right – 4%; left – 4%

III. Interrupted to two segments
   1. Two free sulcal segments
      Right – 12%; left – 0%
   2. Free anterior segment, with posterior segment connected to the inferior frontal sulcus
      Right – 12%; left – 4%
   3. Free posterior segment, with anterior segment connected to the intermediate frontal sulcus
      Right – 12%; left – 0%
   4. Free posterior segment, with anterior segment connected to the superior frontal sulcus
      Right – 4%; left – 8%
   5. Posterior segment connected to the inferior frontal sulcus, with anterior segment connected to the intermediate frontal sulcus
      Right – 4%; left – 0%
   6. Posterior segment connected to the inferior frontal sulcus, with anterior segment connected to the superior frontal sulcus
      Right – 0%; left – 4%

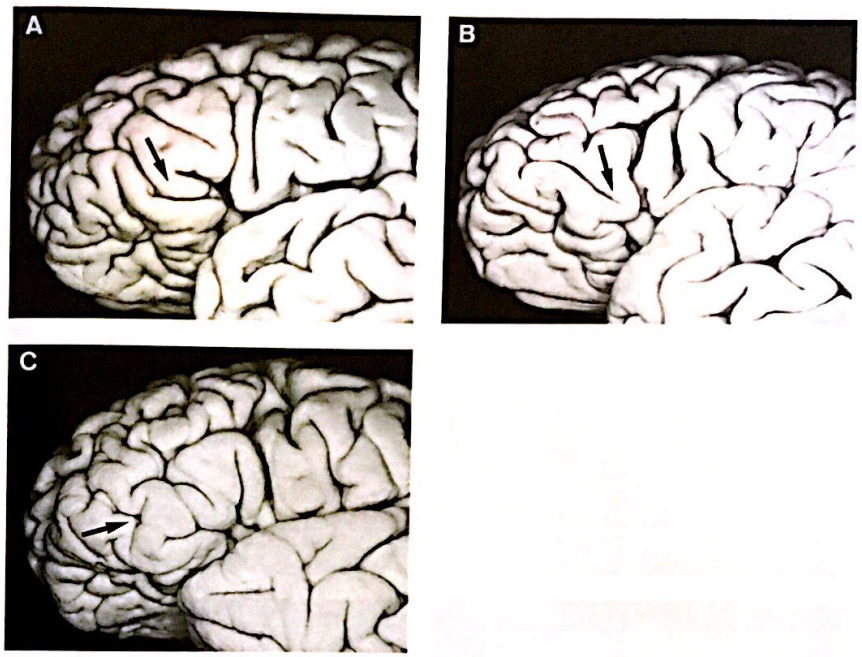
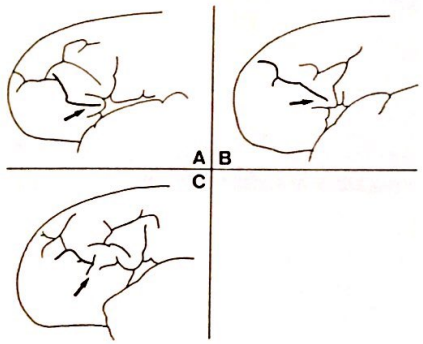


Figure 11.8
Fronto-orbital sulcus: relationship to the horizontal ramus of the Sylvian fissure
(incidence rates in %)

I. Inferior to the horizontal ramus (A)
   Right – 44%; left – 44%

II. Between the horizontal ramus and the ascending ramus (B)
   Right – 32%; left – 36%

III. At the same level as the horizontal ramus (C)
   Right – 16%; left – 12%



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Chapter 12
Temporal and Occipital Lobes: Inferior Surface

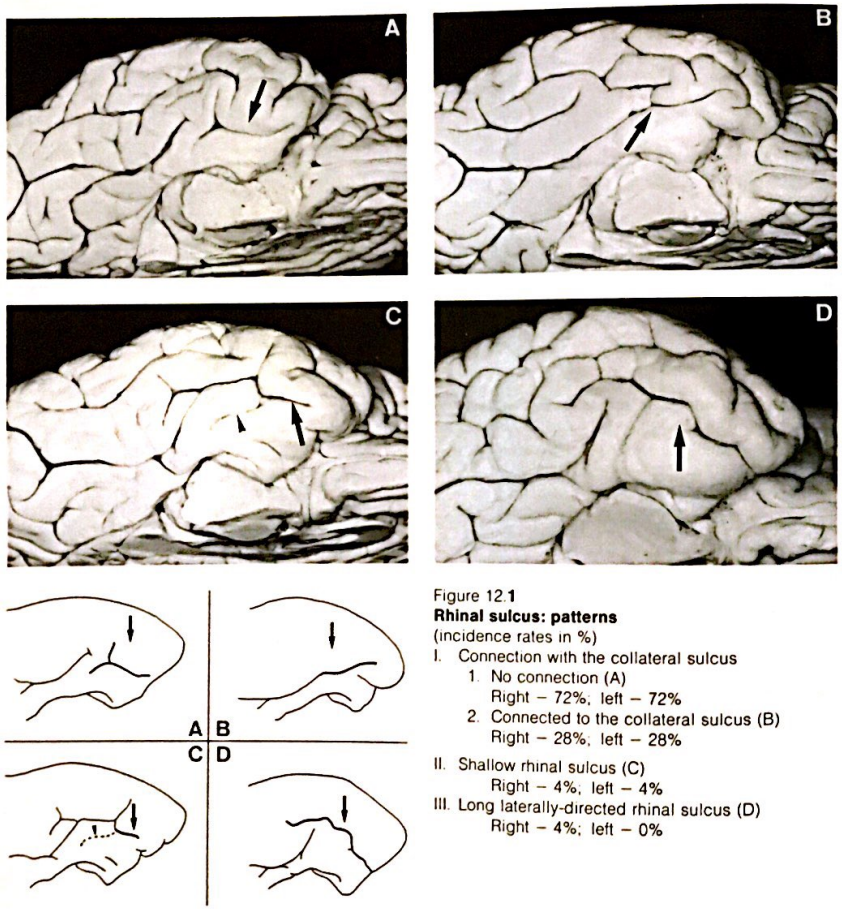


Figure 12.1
Rhinal sulcus: patterns
(incidence rates in %)

I. Connection with the collateral sulcus
   1. No connection (A)
      Right – 72%; left – 72%
   2. Connected to the collateral sulcus (B)
      Right – 28%; left – 28%

II. Shallow rhinal sulcus (C)
      Right – 4%; left – 4%

III. Long laterally-directed rhinal sulcus (D)
      Right – 4%; left – 0%

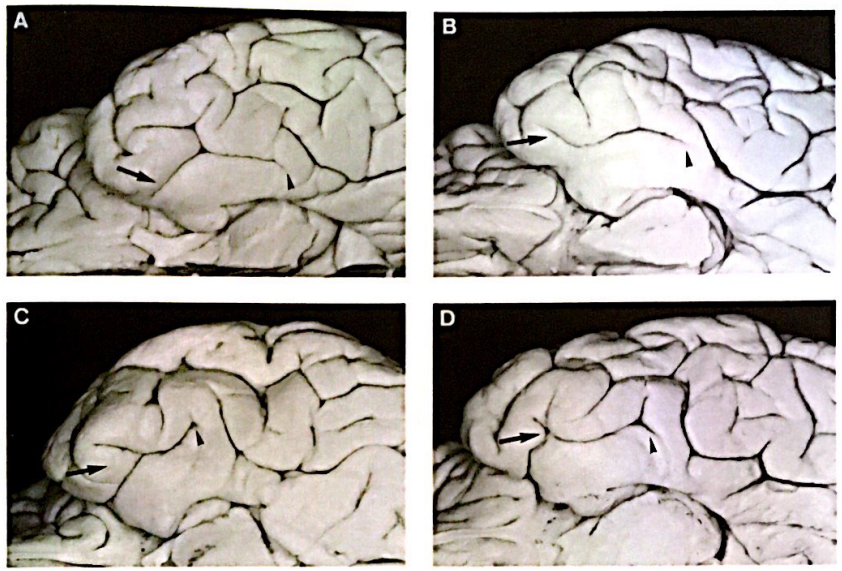
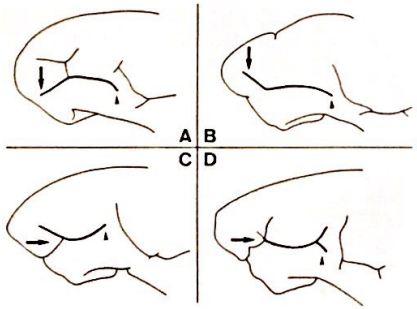


Figure 12.2
Rhinal sulcus: anterior and posterior ends
(incidence rates in %)

I. Anterior end (arrows)
   1. Medial direction (A)
      Right – 28%; left – 16%
   2. Lateral direction (B)
      Right – 56%; left – 52%
   3. Both medial and lateral directions (C,D)
      Right – 16%; left – 32%

II. Posterior end (arrowheads)
   1. Medial direction (A,B)
      Right – 76%; left – 52%
   2. Lateral direction (C)
      Right – 4%; left – 16%
   3. Both medial and lateral directions (D)
      Right – 4%; left – 12%

Note: most medially-directed anterior branches extended into the stem of the Sylvian fissure.



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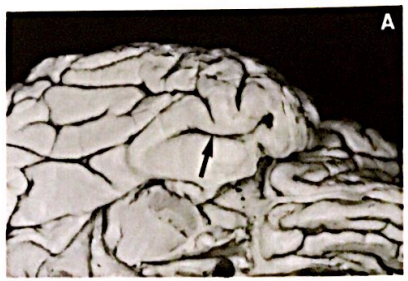
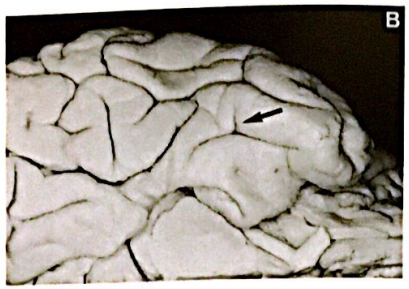
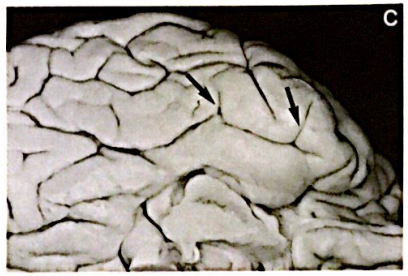






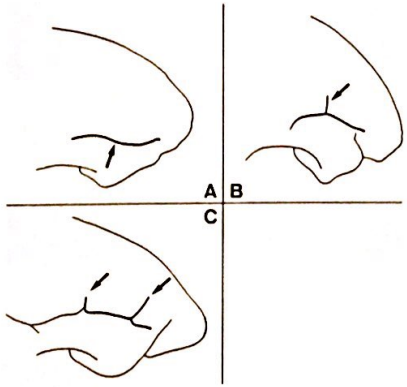
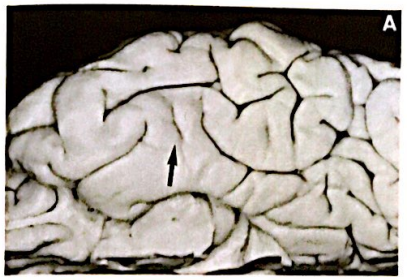


Figure 12.3
Rhinal sulcus: side branches
(incidence rates in %)

Side branches
1. No side branches present (A)
   Right – 56%; left – 56%
2. One laterally-directed side branch (B)
   Right – 36%; left – 36%
3. Two laterally-directed side branches (C)
   Right – 8%; left – 8%
4. Side branch present at the connection with the collateral sulcus (C)
   Right – 12%; left – 24%



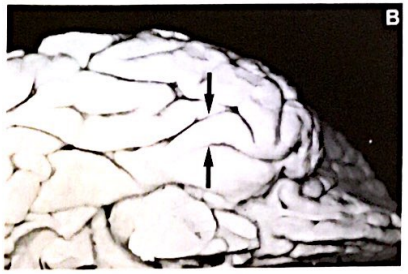
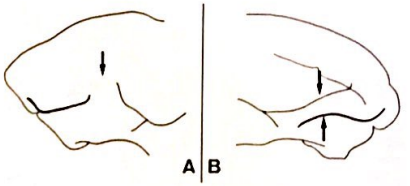
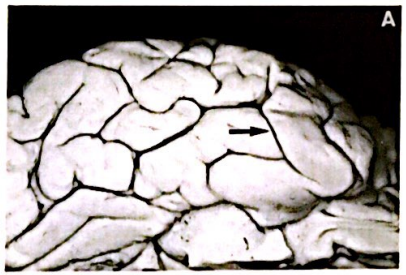


Figure 12.4
Rhinal sulcus: relationship to the collateral sulcus
(incidence rates in %)

Overlapping of collateral sulcus
1. No overlapping (A)
   Right – 28%; left – 32%
2. Short overlapping segment
   Right – 40%; left – 24%
3. Long overlapping segment (B)
   Right – 12%; left – 16%





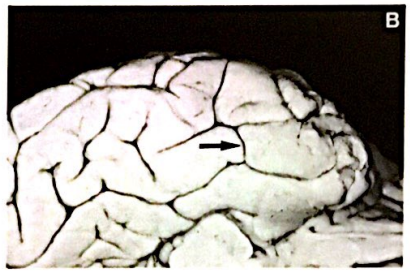
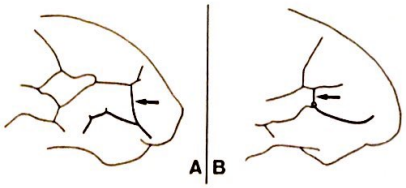


Figure 12.5
Rhinal sulcus: connections
(incidence rates in %)

Connections with the occipitotemporal sulcus
1. True connection (A)
   Right – 4%; left – 4%
2. Pseudoconnection (B)
   Right – 4%; left – 8%



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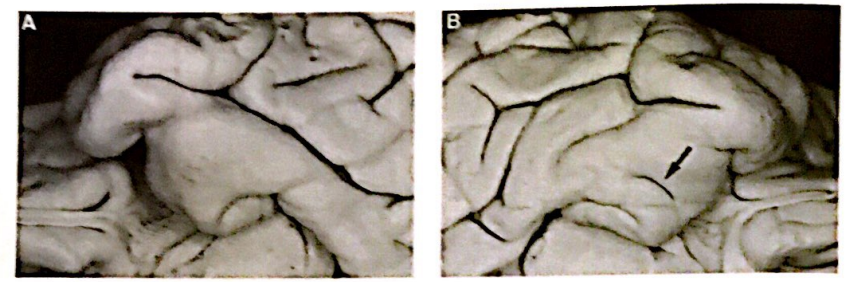


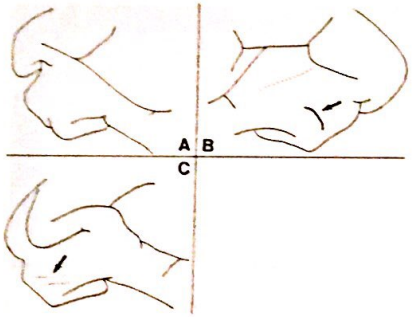


Figure 12.6
Rhinal sulcus: area medial to the rhinal sulcus
(incidence rates in %)

I. Existence of other sulci (B)
   Right – 8%, left – 8%

II. Indentation made by the tentorial edge
   1. None present (A)
      Right – 8%, left – 16%
   2. Shallow indentation
      Right – 52%; left – 24%
   3. Deep indentation (C)
      Right – 32%, left – 60%

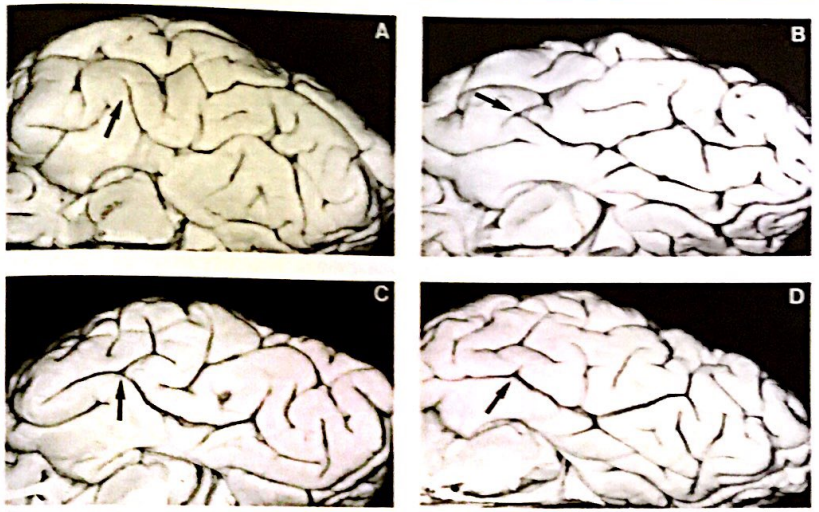
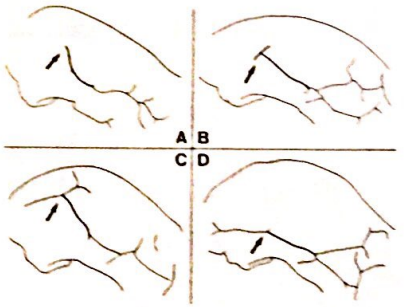


Figure 12.7
Collateral sulcus: anterior end
(incidence rates in %)

Connections
1. No connection with straight end (A)
   Right – 48%, left – 8%
2. No connection with T-shaped end (B)
   Right – 8%, left – 20%
3. With the occipitotemporal sulcus (C)
   Right – 20%; left – 44%
4. With the rhinal sulcus (D)
   Right – 24%, left – 28%



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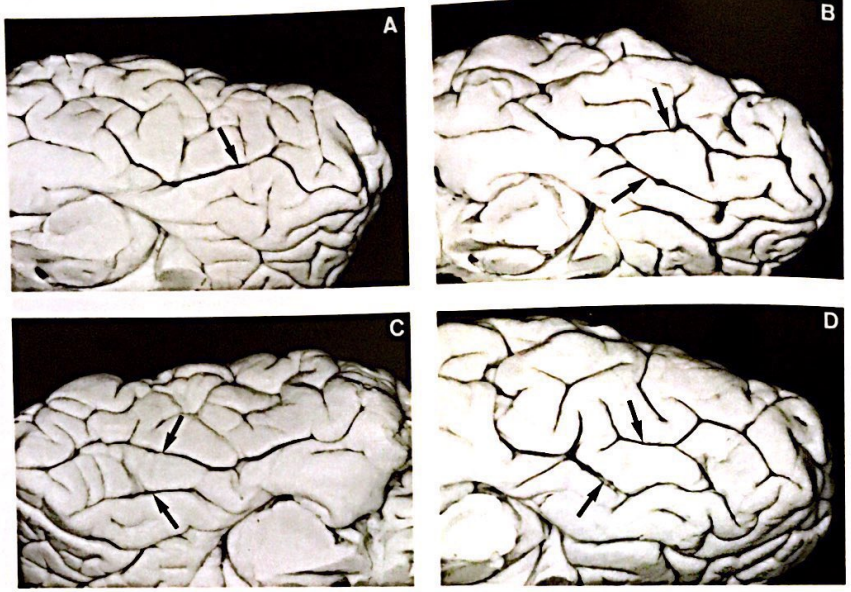


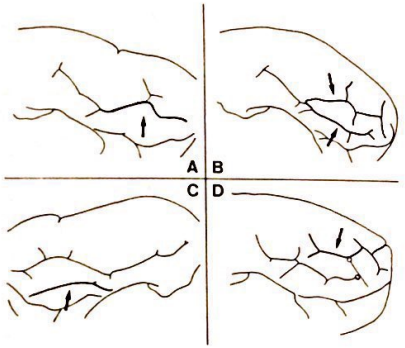


Figure 12.8
Collateral sulcus: pattern of the posterior end
(incidence rates in %)
Patterns

1. Single posterior segment (A)
   Right – 52%; left – 36%
2. Bifurcated posterior segment (B)
   Right – 40%; left – 56%
3. Single and separated medial ramus (C)
   Right – 8%; left – 0%
4. Single and separated lateral ramus (D)
   Right – 0%; left – 4%

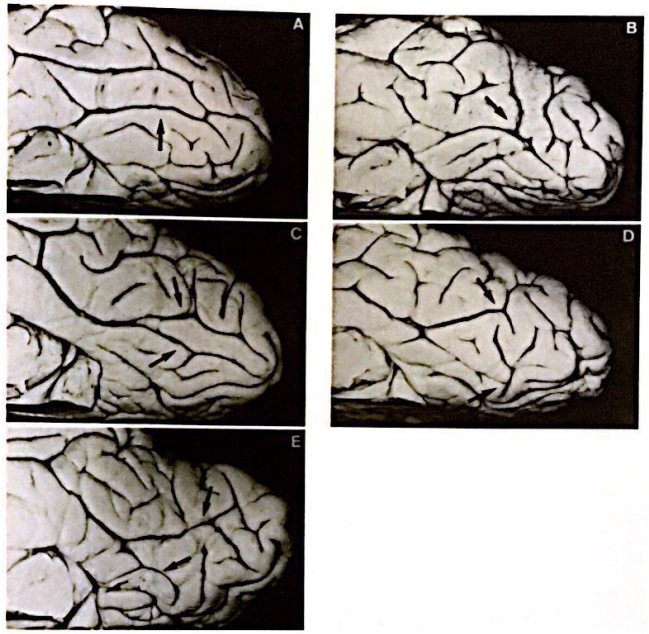
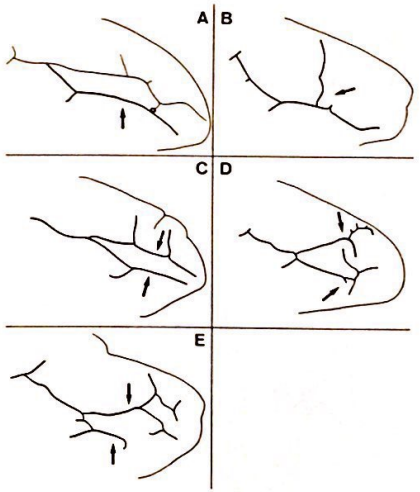


Figure 12.9
Collateral sulcus: pattern of the posterior end on the right
(incidence rates in %)

I. Single posterior end
   1. No long side branch present (A) 24%
   2. With long lateral side branch (B) 20%

II. Bifurcated posterior end
   1. Long medial and long lateral rami (C) 32%
   2. Short medial and short lateral rami (D) 12%
   3. Short medial and long lateral rami (E) 8%



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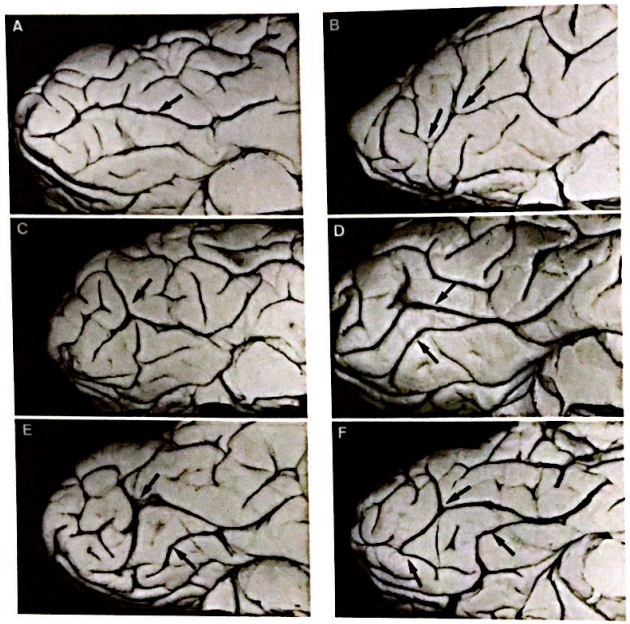


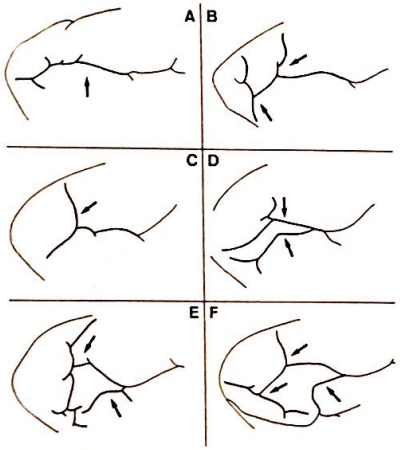


Figure 12.**10**
Collateral sulcus: pattern of the posterior end on the left
(incidence rates in %)

I. Single posterior end
   1. No long side branch present (A) 24%
   2. With long lateral side branch and large T-end (B) 16%
   3. With large T-end (C) 12%

II. Bifurcated posterior end
   1. Long medial and long lateral rami (D) 32%
   2. Short medial and long lateral rami with a large T-end (E) 8%
   3. Short medial and long lateral rami with a large lateral side branch and a large T-end (F) 12%

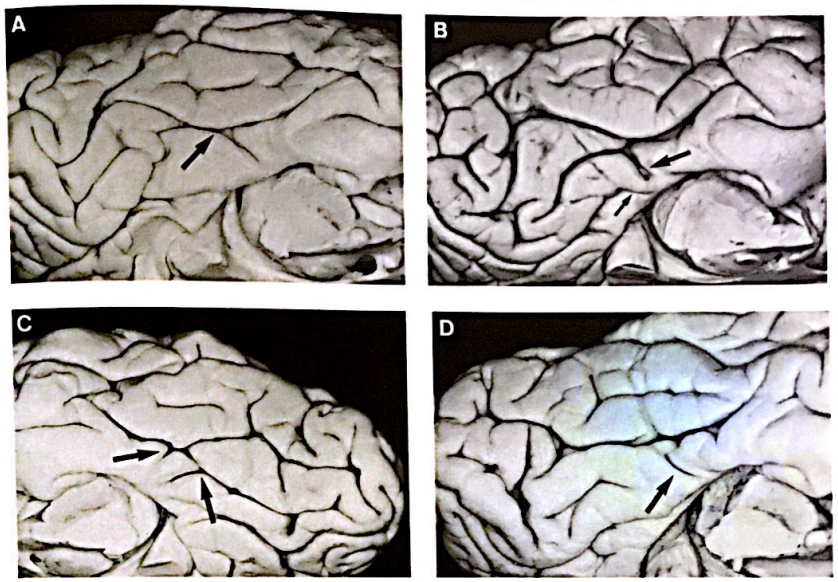
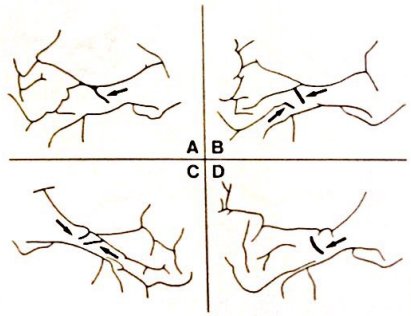


Figure 12.**11**
Collateral sulcus: side branches
(incidence rates in %)

Parahippocampal ramus
1. Not present
   Right – 16%; left – 8%
2. Present as a single sulcus
   a As a side branch of the main trunk (A)
   Right – 64%; left – 60%
   b As a side branch of the medial ramus (B)
   Right – 4%; left – 12%
   c As a free sulcus (D)
   Right – 4%; left – 0%
3. Present as a double sulcus
   a One sulcus from the main trunk and the other from the medial ramus (C)
   Right – 4%; left – 8%
   b Both from the medial ramus
   Right – 0%; left – 4%
   c One sulcus from the main trunk and the other as a free sulcus
   Right – 8%; left – 0%

Note: the posterolateral end of the parahippocampal ramus indicates the posterior end of the hippocampus in the temporal horn.



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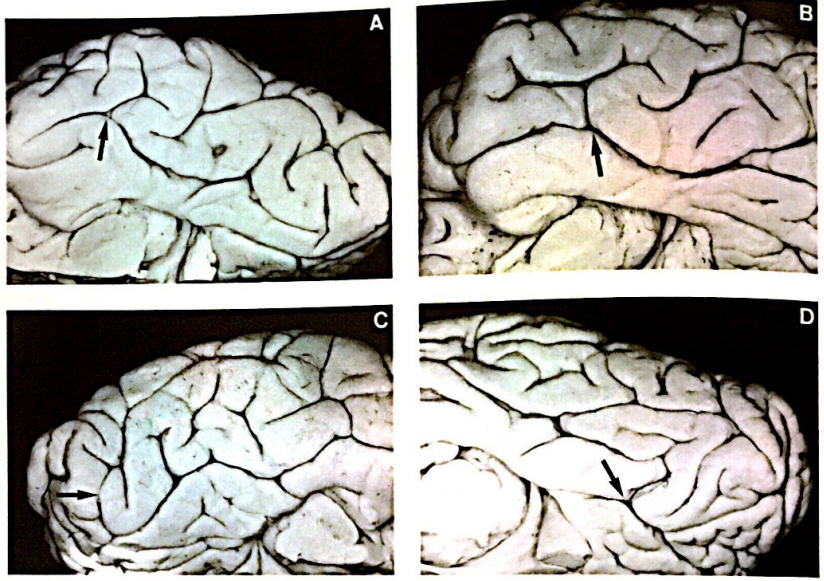


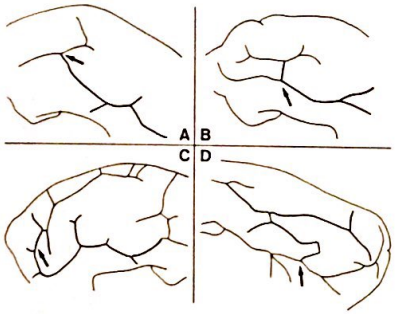


Figure 12.**12**
Collateral sulcus: connections
(incidence rates in %)

I. Connection with the rhinal sulcus (see Fig. 12.**1B**)

II. Connection with the occipitotemporal sulcus
   1. Anterior end with end-to-side connection (A)
      Right – 20%; left – 44%
   2. Anterior end with side branch connection (B)
      Right – 0%; left – 4%
   3. Posterior end (C)
      Right – 8%; left – 8%

III: Connection with the calcarine sulcus (D)
   Right – 8%; left – 4%

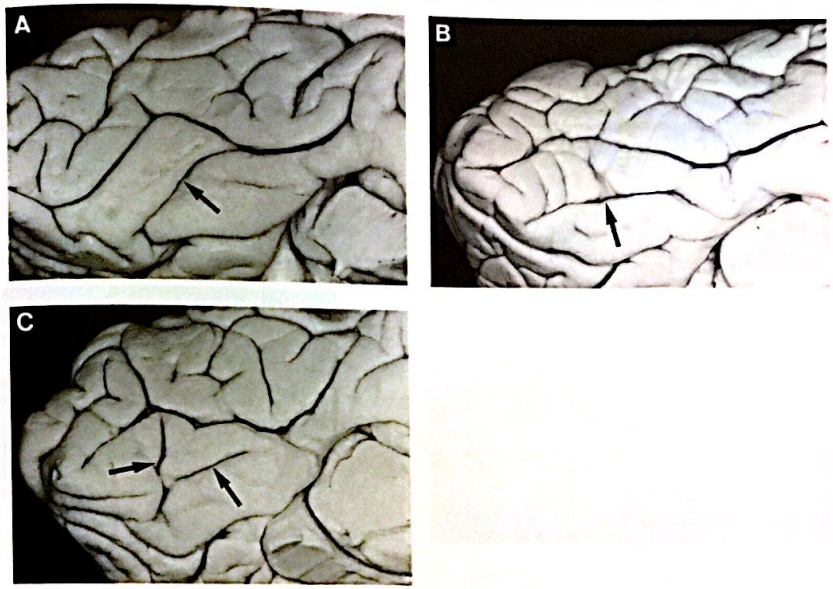
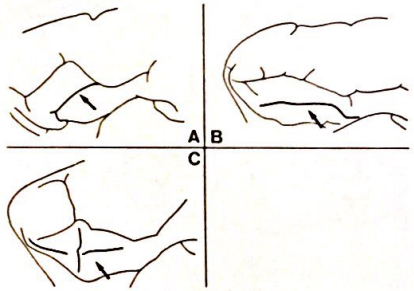


Figure 12.**13**
Collateral sulcus: relationship to the intralingual sulcus
(incidence rates in %)

I. Intralingual sulcus as a free sulcus over the lingual gyrus
   1. Longitudinal type (B)
      Right – 36%; left – 28%
   2. Transverse type
      Right – 8%; left – 20%
   3. Combination of longitudinal and transverse types (C)
      Right – 16%; left – 16%

II. Intralingual sulcus as the medial ramus of the collateral sulcus (A)
   Right – 40%; left – 56%



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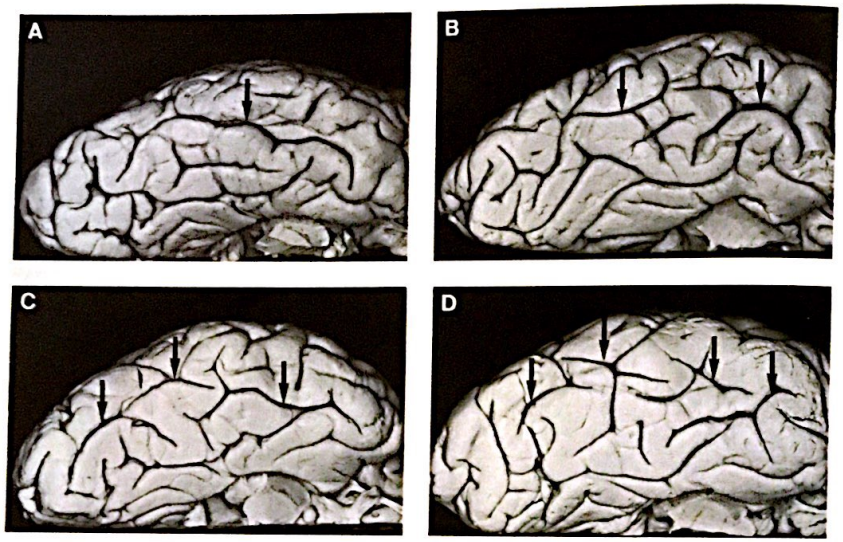


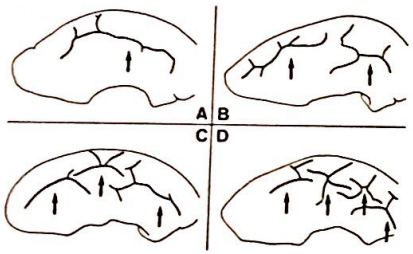


Figure 12.14
Occipitotemporal sulcus: patterns
(incidence rates in %)

I. Interruptions
   1. Continuous (A)
      Right – 48%; left – 24%
   2. Interrupted to two segments (B)
      Right – 32%; left – 52%
   3. Interrupted to three segments (C)
      Right – 16%; left – 8%
   4. Interrupted to four segments (D)
      Right – 4%; left – 0%

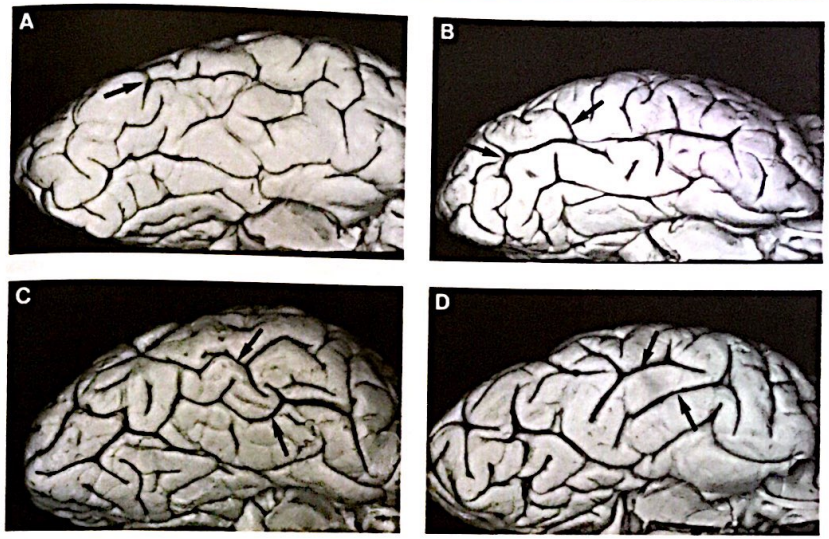
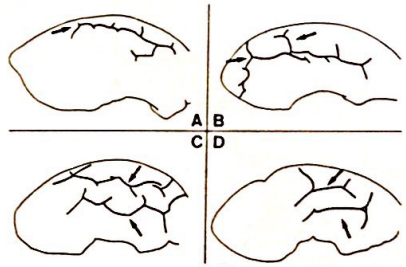


Figure 12.15
Occipitotemporal sulcus: patterns
(incidence rates in %)

II. Course
   1. Lateral course – near the inferolateral margin of the hemisphere (A)
      Right – 84%; left – 64%
   2. Medial course (B)
      Right – 16%; left – 36%

III. Length
   1. Short – posterior end near the preoccipital incisura (A)
      Right – 68%; left – 60%
   2. Long – posterior end near the occipital pole (B)
      Right – 32%; left – 40%

IV. Double parallel type (C,D)
      Right – 8%; left – 4%



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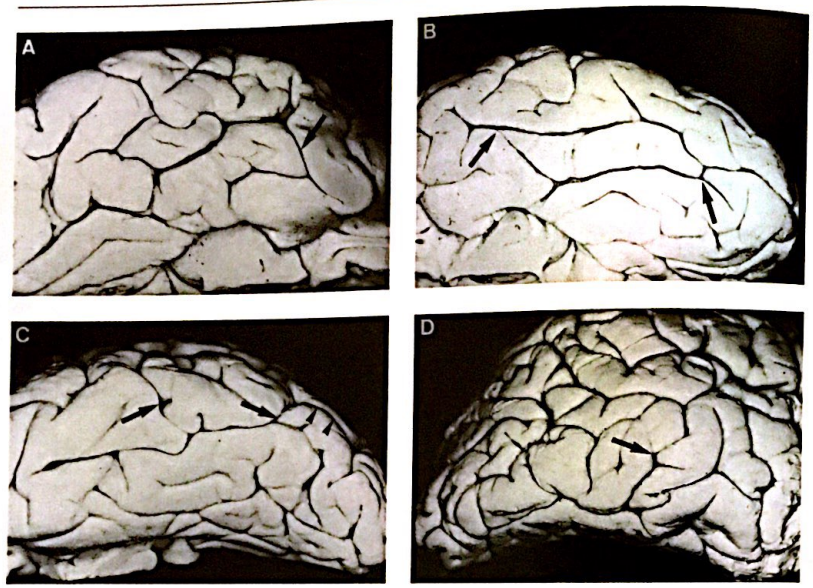


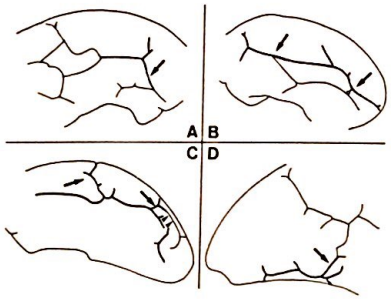


Figure 12.**16**
Occipitotemporal sulcus: side branches and connections
(incidence rates in %)

I. Side branch crossing the inferolateral margin of the hemisphere
   1. Anterior segment (C,D)
      Right – 8%; left – 20%
   2. Posterior segment near the preoccipital incisura (C)
      Right – 32%; left – 36%

II. Connections
   1. With the rhinal sulcus (A) (see Fig. 12.**5**)
   2. With the collateral sulcus (B) (see Fig. 12.**12**)
   3. With the inferior temporal sulcus anterior to the preoccipital incisura (C)
      Right – 24%; left – 20%
   4. With the inferior temporal sulcus at the preoccipital incisura
      Right – 12%; left – 40%
   5. With the superior temporal sulcus (D)
      Right – 20%; left – 4%
   6. With the lateral occipital sulcus (C, arrowheads)
      Right – 4%; left – 8%

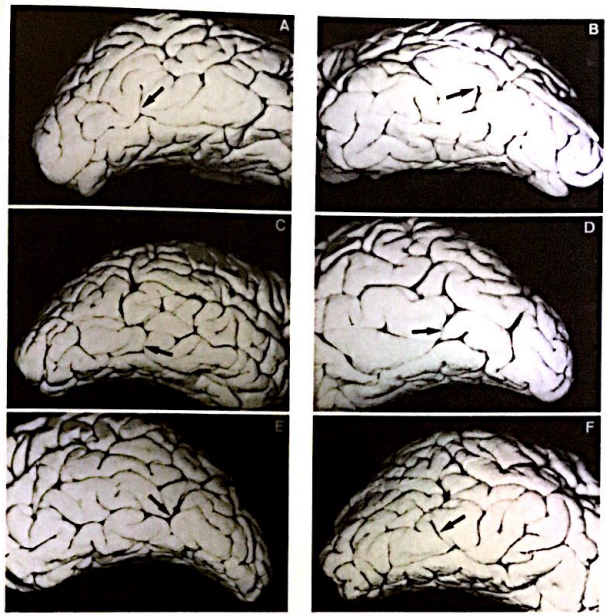
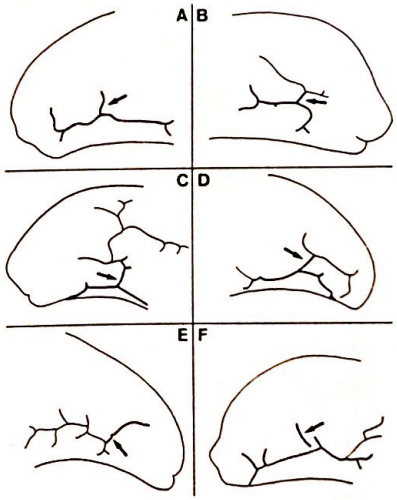


Figure 12.**17**
Occipitotemporal sulcus: side branch at the preoccipital incisura
(incidence rates in %)

I. As a side branch of the occipitotemporal sulcus
   1. No connections with other sulci (A)
      Right – 44%; left – 28%
   2. Also connected with the inferior temporal sulcus (B)
      Right – 8%; left – 28%
   3. Also connected with the superior temporal sulcus (C)
      Right – 16%; left – 4%
   4. Also connected with the lateral occipital sulcus (D)
      Right – 4%; left – 8%

II. As a side branch of the inferior temporal sulcus (E)
      Right – 20%; left – 28%

III. As a free sulcus (F)
      Right – 8%; left – 0%



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4

Sulcal Patterns of the Cerebral Hemispheres: Medial Surface

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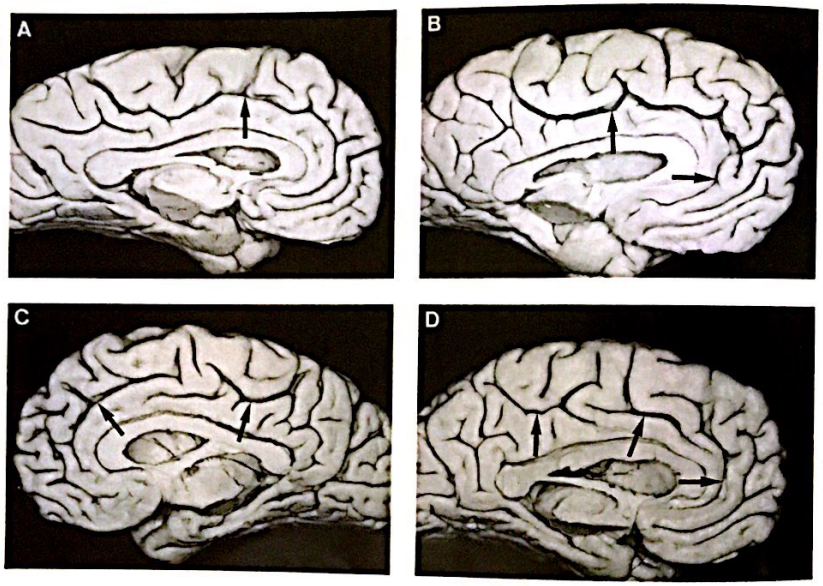
Chapter 13
Frontal and Parietal Lobes: Medial Surface



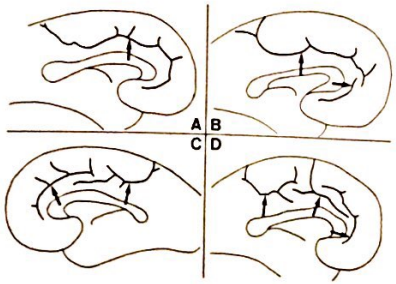


Figure 13.1
Cingulate sulcus: patterns
(incidence rates in %)

I. Interruptions
1. No interruption (A)
Right – 60%; left – 56%
2. Interrupted to two segments – anterior interruption (B)
Right – 4%; left – 16%
3. Interrupted to two segments – posterior interruption (C)
Right – 24%; left – 12%
4. Interrupted to three segments (D)
Right – 16%, left – 16%

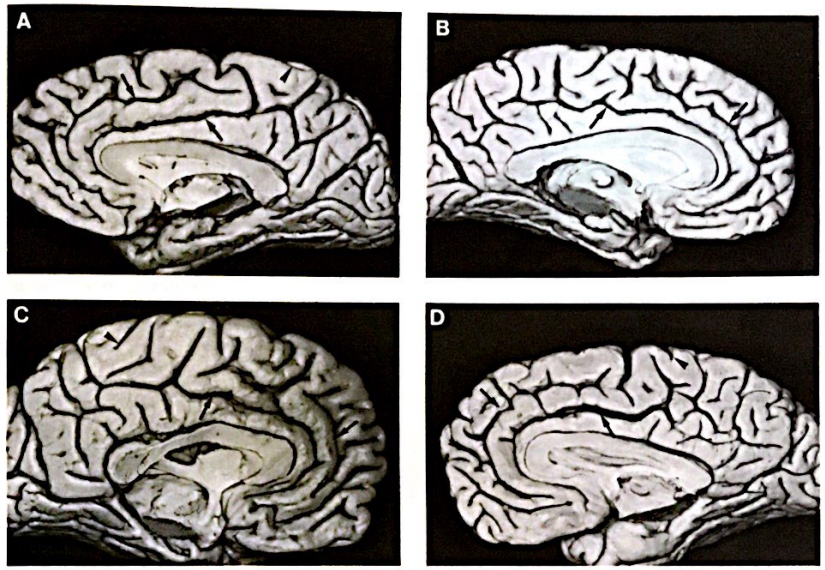
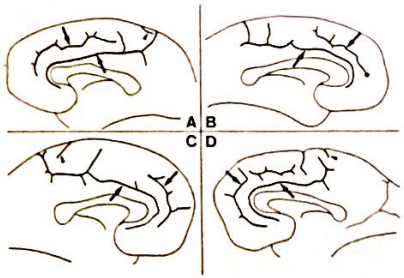


Figure 13.2
Cingulate sulcus: patterns
(incidence rates in %)

II. Double parallel type (A–D)
Right – 24%; left – 24%

III: Relationship of the marginal ramus to the central sulcus (arrowheads)
1. Ends posterior to the central sulcus (A,C)
Right – 100%; left – 96%
2. Ends anterior to the central sulcus (D)
Right – 0%; left - 4%

Note: the double parallel type of cingulate sulcus has a very shallow callosal sulcus around the genu of the corpus callosum.



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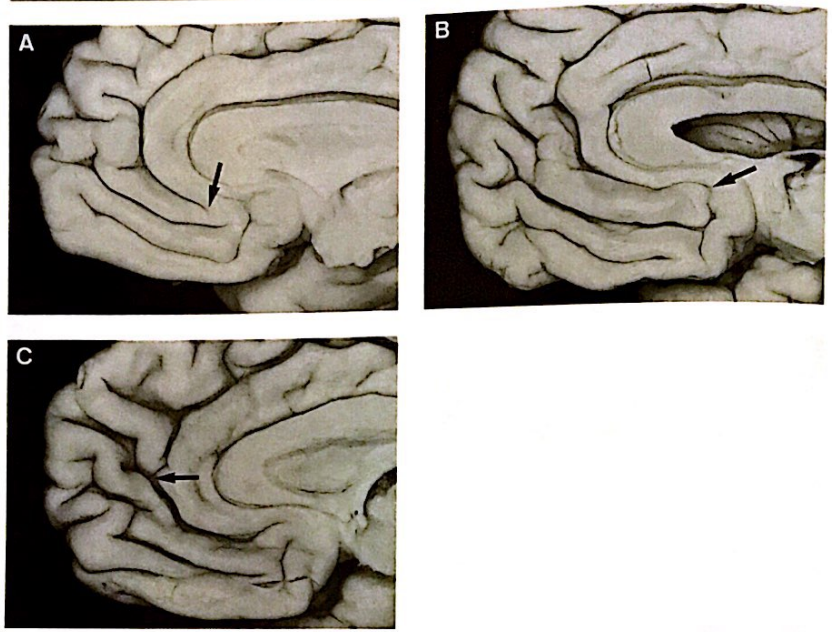


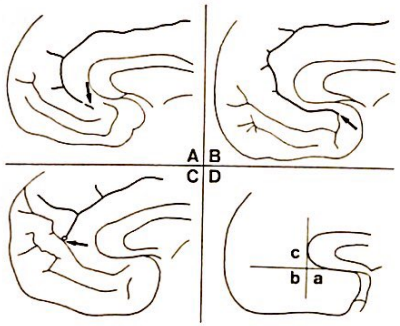


Figure 13.3
Cingulate sulcus: anterior end
(incidence rates in %)

I. Connections
   1. No connections (A)
      Right – 56%; left – 48%
   2. With the anterior parolfactory sulcus (B)
      Right – 36%; left – 28%
   3. With the superior rostral sulcus (C)
      Right – 8%; left – 24%

II. Position of anterior end (D)
   1. Position a (B)
      Right – 76%; left – 72%
   2. Position b (see Fig. 13.**1A**)
      Right – 16%; left – 12%
   3. Position c (C)
      Right – 8%; left – 16%

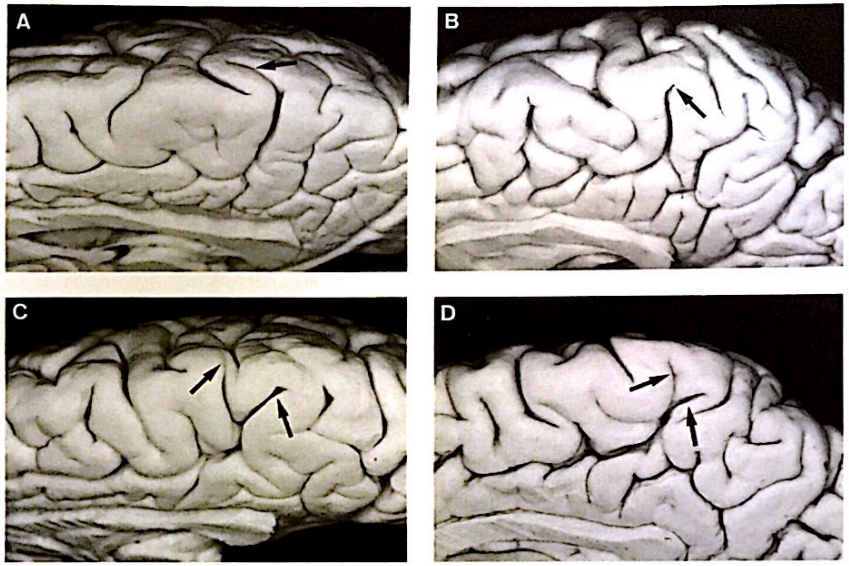
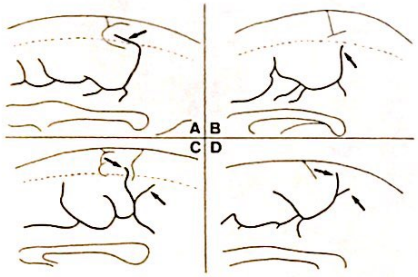


Figure 13.4
Cingulate sulcus: posterior end (marginal ramus)
(incidence rates in %)

I. Straight end
   1. Extends to the lateral surface (A)
      Right – 40%; left – 56%
   2. Ends over the medial surface (B)
      Right – 16%; left – 4%

II. Y-shaped end
   1. Anterior ramus extends to the lateral surface (C)
      Right – 16%; left – 36%
   2. Both rami extend to the lateral surface
      Right – 16%; left – 4%
   3. Both rami end over the medial surface (D)
      Right – 12%; left – 0%



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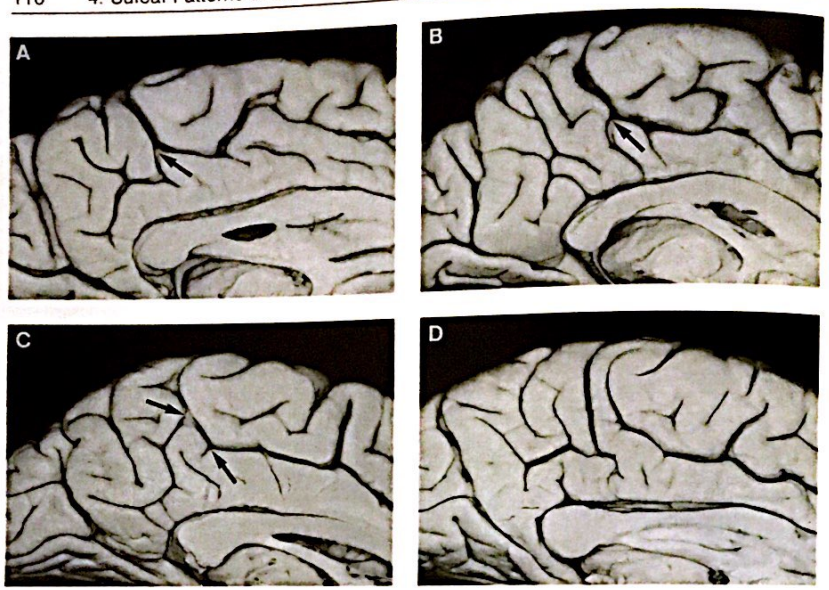


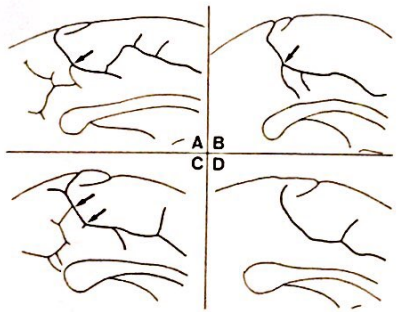


Figure 13.5
Cingulate sulcus: marginal ramus
(incidence rates in %)

As the terminal ascending segment of the cingulate sulcus

1. With connection to the subparietal sulcus (A)
   Right – 36%; left – 28%
2. With side branch (B)
   Right – 44%; left – 44%
3. With connection to the subparietal sulcus and a side branch (C)
   Right – 12%; left – 12%
4. No connections or side branches (D)
   Right – 8%; left – 16%

Note: when present, side branches or connections to the subparietal sulcus were considered to arise from the origin of the marginal ramus.

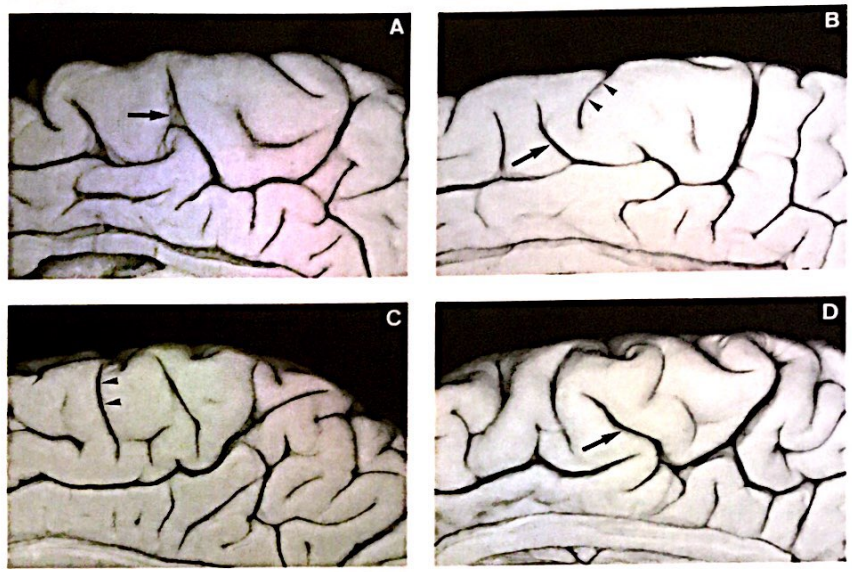
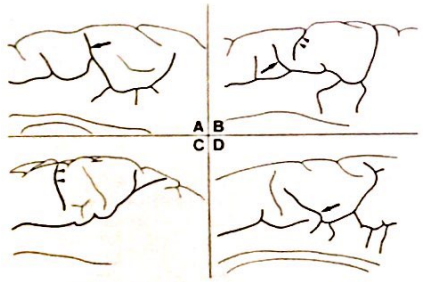


Figure 13.6
Cingulate sulcus: paracentral sulcus
(incidence rates in %)

As the anterior border of the paracentral lobule

1. As a side branch of the cingulate sulcus (A)
   Right – 24%; left – 32%
2. As a sulcus from the lateral surface (C)
   Right – 12%; left – 12%
3. As both a side branch of the cingulate sulcus and as a sulcus from the lateral surface (B)
   Right – 28%; left – 48%
4. As an anterior extension of the posterior segment of the cingulate sulcus (D)
   Right – 20%; left – 8%



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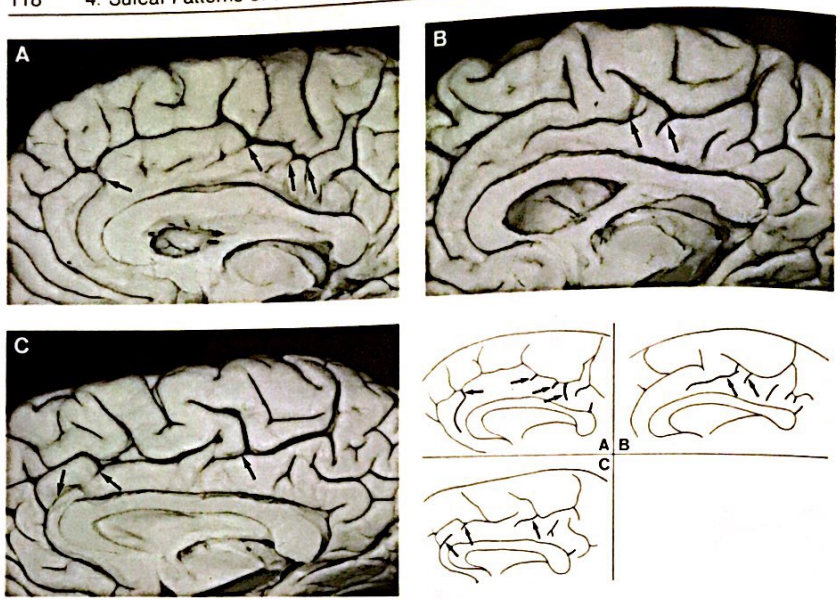

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Figure 13.7
Cingulate sulcus: side branches
(incidence rates in %)

I. Inferiorly-directed side branches (A–C)
   1. Anterior half of the cingulate sulcus

Number	*Right*	*Left*
0(B)	72%	52%
1(A)	24%	44%
2(C)	4%	4%

   2. Posterior half of the cingulate sulcus

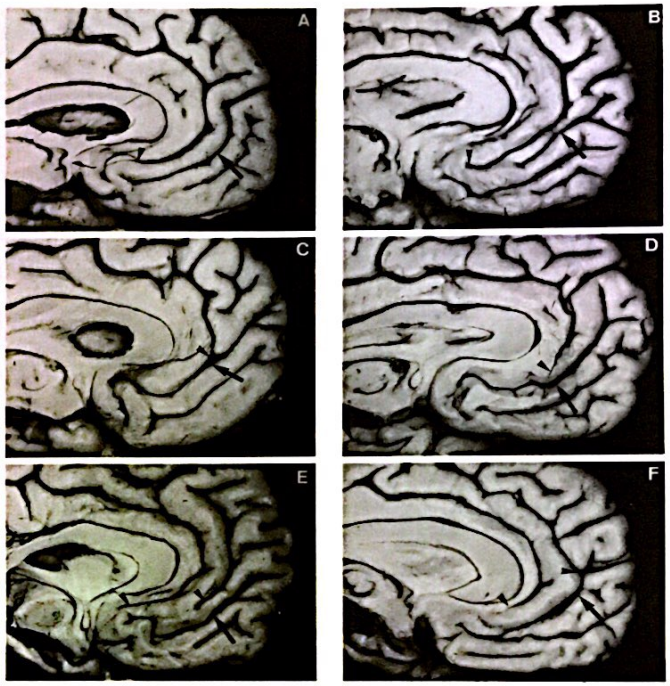
Number	*Right*	*Left*
0	0%	4%
1(C)	8%	16%
2(B)	40%	52%
3(A)	40%	16%
4	12%	8%
5	4%	4%

II. Long side branches
   1. Anterior location directed anteriorly (A)
      Right – 4%; left – 8%
   2. Anterior location directed posteriorly (C)
      Right – 8%; left – 4%
   3. Posterior location (B,C)
      Right – 16%; left – 4%

Figure 13.8 ▷
Superior rostral sulcus: patterns and connections
(incidence rates in %)

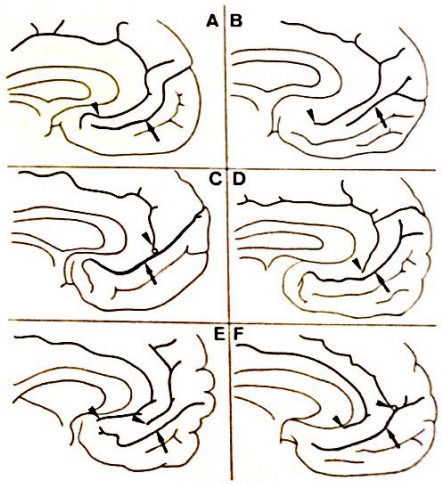
I. Relative length
   1. Long (A)
      Right – 72%; left – 84%
   2. Short (B)
      Right – 28%; left – 16%

II. Relationship of the superior rostral sulcus to the cingulate sulcus
   1. Posterior origin of the cingulate sulcus and a long superior rostral sulcus (A)
      Right – 28%; left – 36%
   2. Posterior origin of the cingulate sulcus and a short superior rostral sulcus (B)
      Right – 28%; left – 16%
   3. Anterior origin of the cingulate sulcus with a connection to the superior rostral sulcus (C)
      Right – 8%; left – 24%
   4. Anterior origin of the cingulate sulcus without connection to the superior rostral sulcus (D)
      Right – 12%; left – 4%
   5. Double cingulate sulcus without connection to the superior rostral sulcus (E)
      Right – 16%; left – 8%



   6. Double cingulate sulcus with connection to the superior rostral sulcus via the anterior segment (F)
      Right – 8%; Left – 12%

III. Connection to the anterior parolfactory sulcus (C,D)
      Right – 32%; left – 40%



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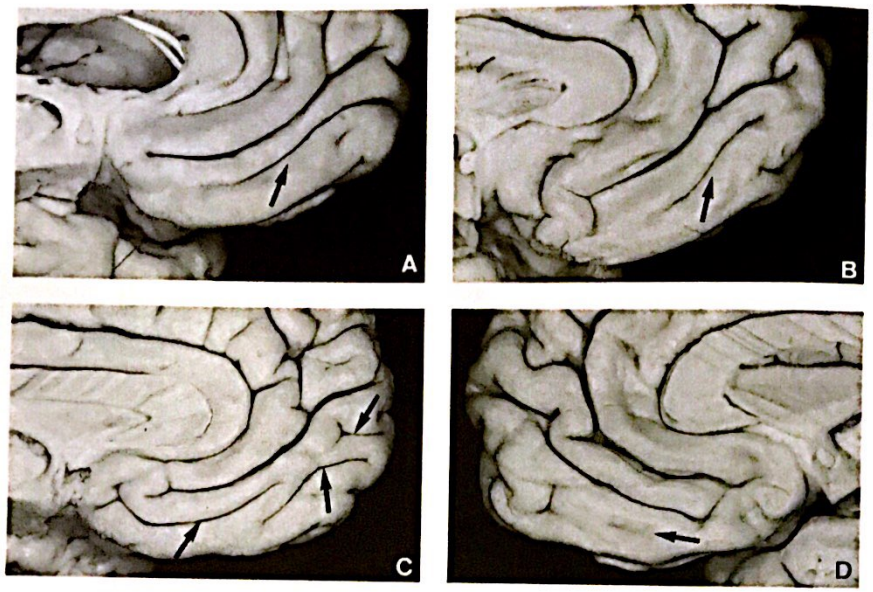


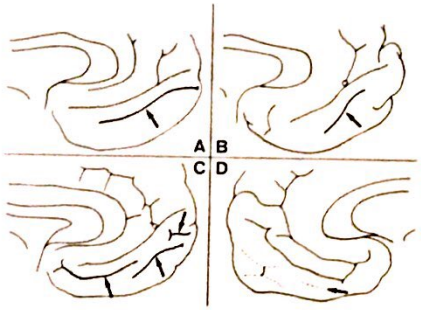
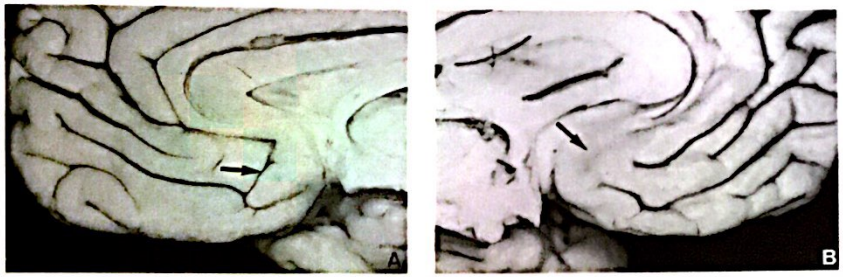


Figure 13.9
Inferior rostral sulcus: patterns and connections
(incidence rates in %)

I. Patterns
   1. Long and single sulcus (A)
      Right – 64%; left – 44%
   2. Short and single sulcus (B)
      Right – 4%; left – 32%
   3. Multiple sulci (C)
      Right – 20%; left – 20%
   4. Shallow indentation (D)
      Right – 16%; left – 0%
   5. No inferior rostral sulcus present
      Right – 0%; left – 4%

II. Existence of accessory sulci inferior to the inferior rostral sulcus
      Right – 20%; left – 20%

III. Connection with the anterior parolfactory sulcus (C)
      Right – 16%; left – 8%



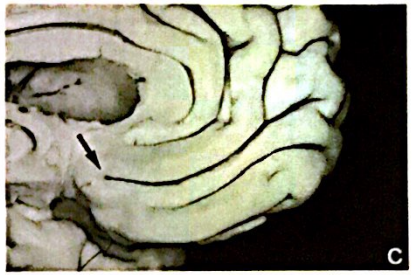
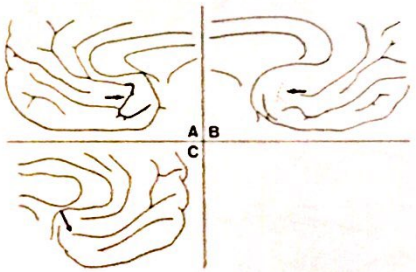


Figure 13.10
Anterior parolfactory sulcus: patterns and connections
(incidence rates in %)



I. Patterns
   1. Long vertical sulcus (A)
      Right – 56%; left – 28%
   2. Short vertical sulcus
      Right – 16%; left – 28%
   3. Shallow indentation (B)
      Right – 20%; left – 16%
   4. No anterior parolfactory sulcus present (C)
      Right – 0%; left – 24%

II. Connections
   1. With the cingulate sulcus (A)
      Right – 36%; left – 20%
   2. With the superior rostral sulcus (see Fig 13.8C,D)
      Right – 32%; left – 40%
   3. With the inferior rostral sulcus (A)
      Right – 16%; left – 8%

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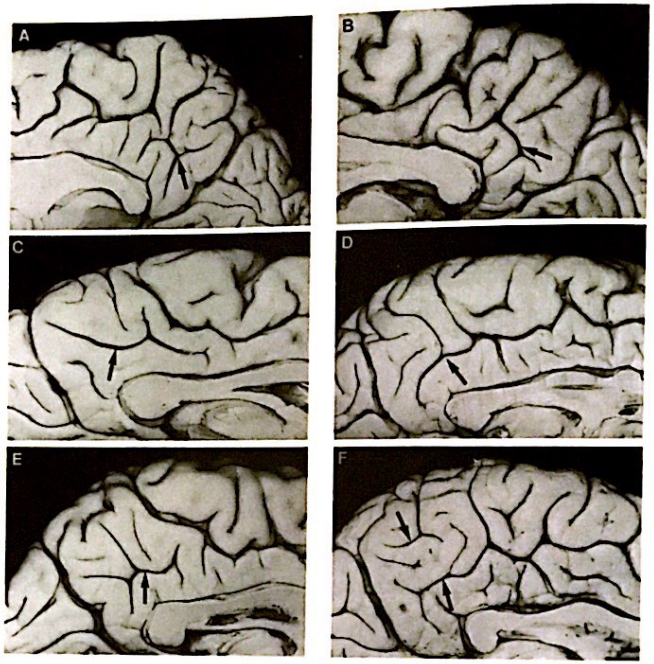


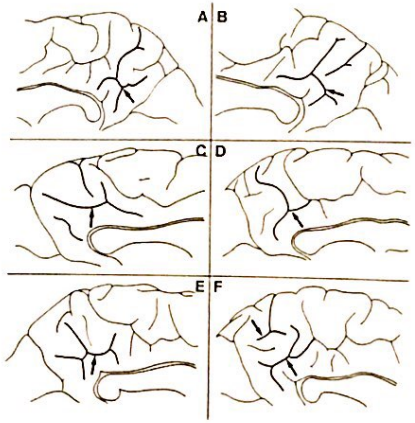


Figure 13.**11**
Subparietal sulcus: patterns and connections
(incidence rates in %)

I. Patterns
1. H-pattern (A)
Right – 28%; left – 40%
2. Split H-pattern (B)
Right – 36%; left – 24%
3. Oblique (C)
Right – 4%; left – 12%
4. Single upward branch (D)
Right – 12%; left – 4%
5. Triple upward branches (E)
Right – 4%; left – 12%
6. Double horizontal sulci (F)
Right – 16%; left – 8%

II. Connection with the cingulate sulcus (D,F)
Right – 36%; left – 28%

III. Upwardly-directed branches crossing the superior margin of the hemisphere over the precuneus (B,D,F)

Number	*Right*	*Left*
0	4%	0%
1(D,F)	72%	68%
2(B)	20%	28%
3	4%	4%

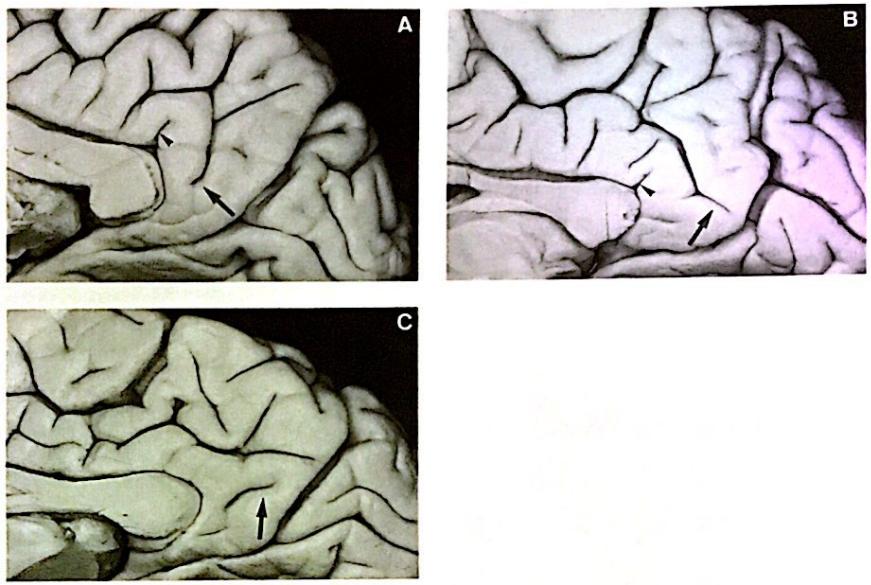
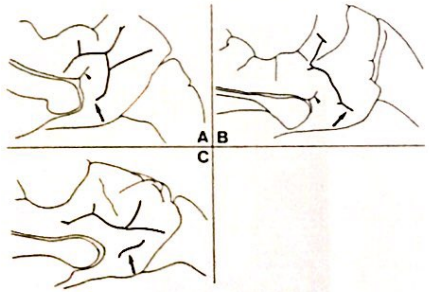


Figure 13.**12**
Subparietal sulcus: posterior end and side branches
(incidence rates in %)



I. Posterior end
1. Directed anteriorly towards the splenium (A)
Right – 88%; left – 84%
2. Directed posteriorly (B)
Right – 4%; left – 12%
3. Directed posteriorly with a small free sulcus present (C)
Right – 4%; left – 8%

II. Side branches of the subparietal sulcus

Number	*Right*	*Left*
0	4%	4%
1	16%	24%
2	68%	64%
3	12%	8%

III. Side branches of the callosal sulcus over the splenium (A–B, arrowheads)

Number	*Right*	*Left*
0(C)	20%	36%
1(A,B)	48%	40%
2	32%	24%

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Chapter 14
Occipital Lobe: Medial Surface

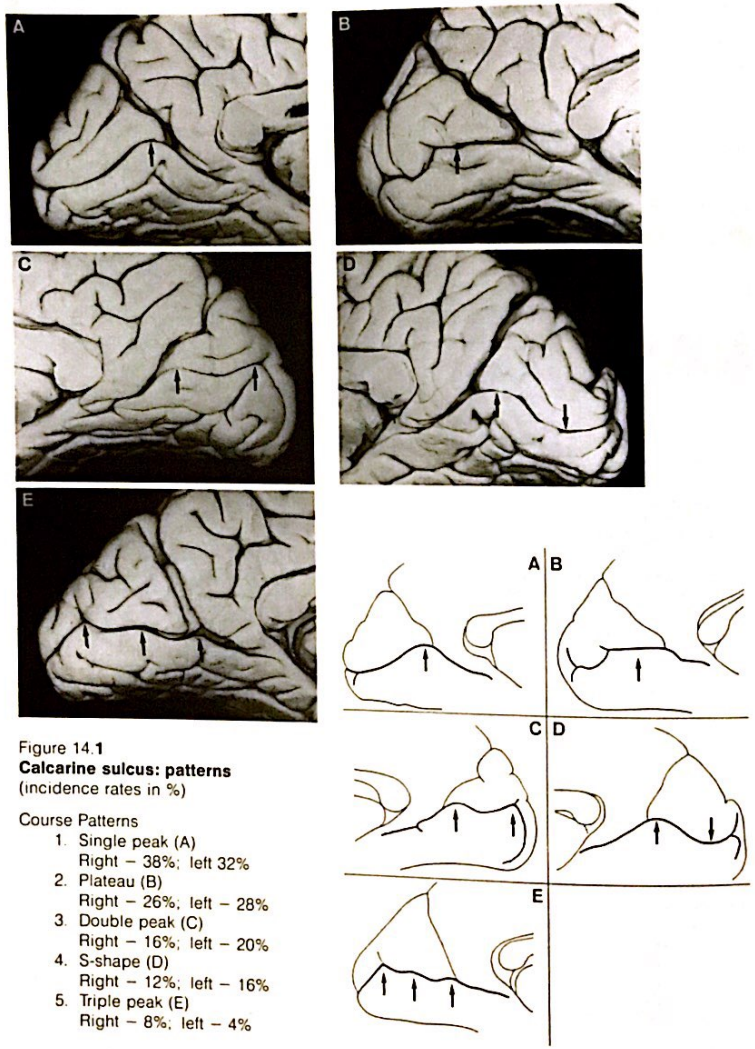


Figure 14.1
Calcarine sulcus: patterns
(incidence rates in %)

Course Patterns

1. Single peak (A)
   Right – 38%; left 32%
2. Plateau (B)
   Right – 26%; left – 28%
3. Double peak (C)
   Right – 16%; left – 20%
4. S-shape (D)
   Right – 12%; left – 16%
5. Triple peak (E)
   Right – 8%; left – 4%

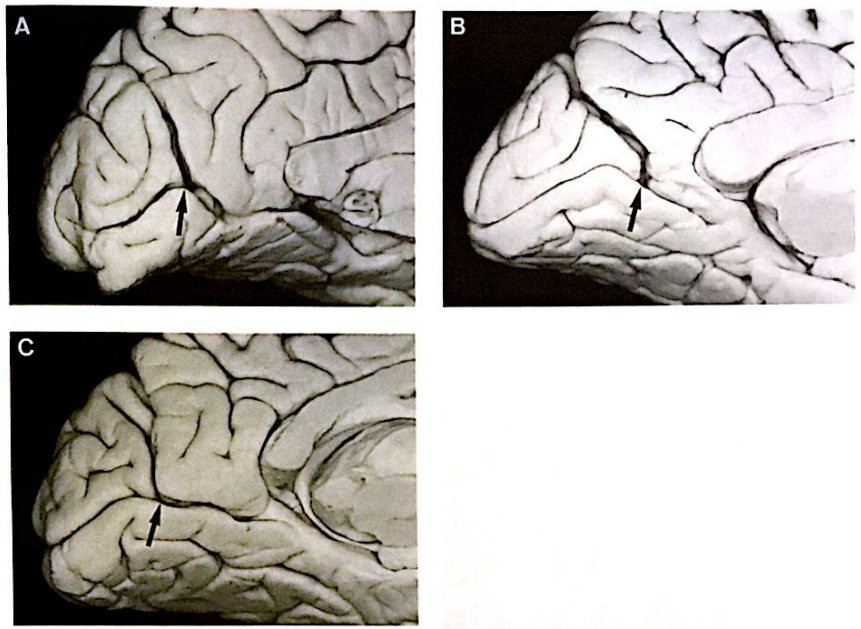
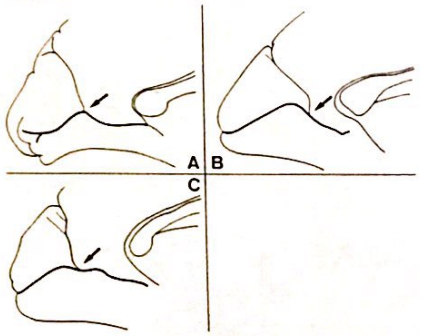


Figure 14.2
Calcarine sulcus: junction with the parieto-occipital sulcus
(incidence rates in %)

Position of the junction

1. At the first peak of the calcarine sulcus (A)
   Right – 64%; left – 64%
2. Anterior to the first peak (B)
   Right – 32%; left – 28%
3. Posterior to the first peak (C)
   Right – 0%; left – 4%



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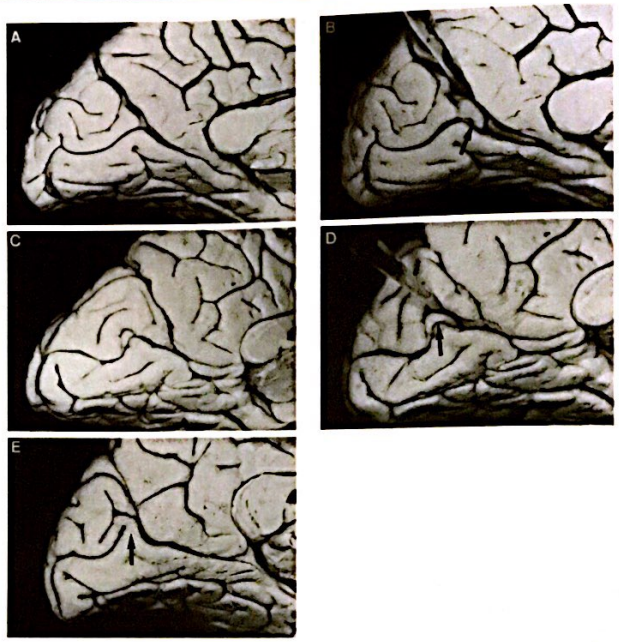


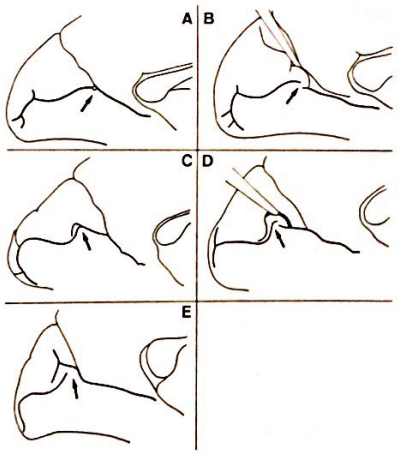


Figure 14.3
Calcarine sulcus: interruptions
(incidence rates in %)

I. Anterior interruption
   1. At the junction with the parieto-occipital sulcus (A=B)
      Right – 4%; left – 4%
   2. Posterior to the junction with the parieto-occipital sulcus (C=D,E)
      Right – 0%; left – 8%

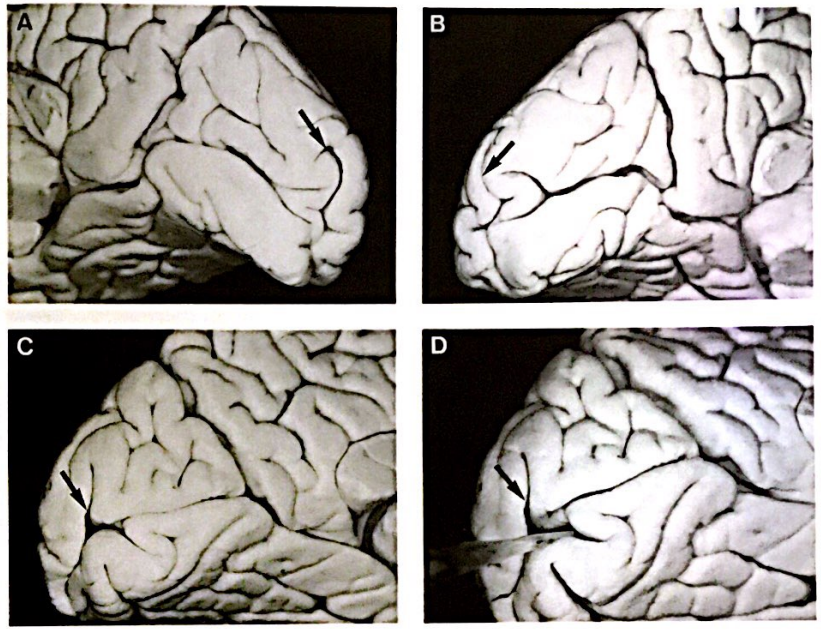
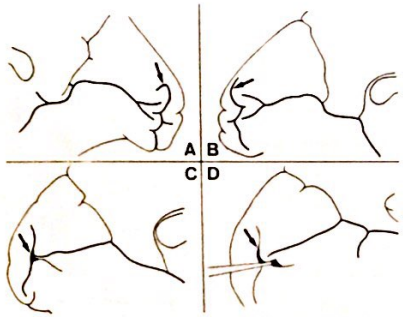


Figure 14.4
Calcarine sulcus: interruptions
(incidence rates in %)

II. Posterior interruption
   1. True interruption of the vertical terminal segment (A,B)
      Right – 12%; left – 16%
   2. Pseudocontinuation of the vertical terminal segment (C=D)
      Right – 8%; left – 4%

Note: the vertical terminal segment is also referred to as the extreme calcarine sulcus.



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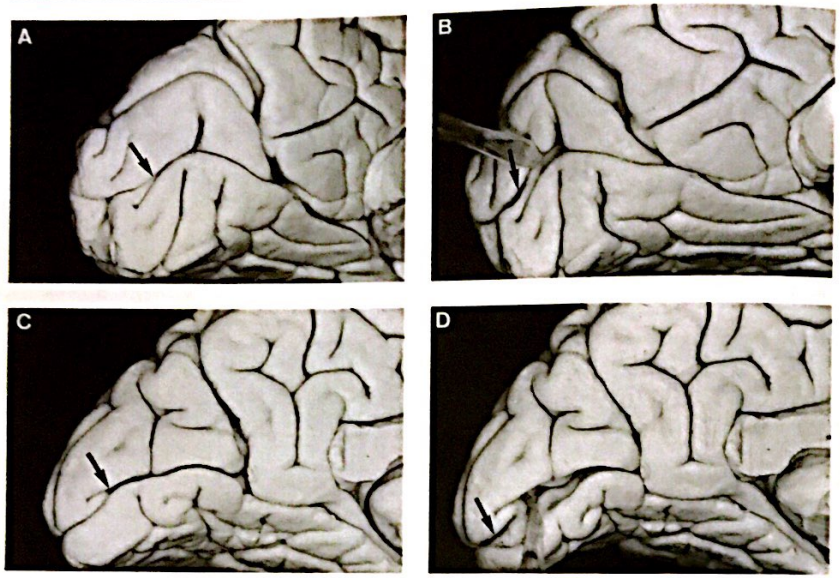


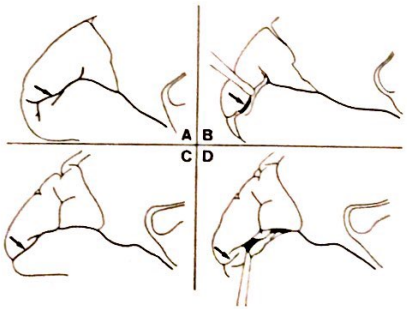


Figure 14.5
Calcarine sulcus: interruptions
(incidence rates in %)

II. Posterior interruption
  3. Separate horizontal terminal segment (A=B, C=D)
     Right – 0%; left – 16%

Note: the horizontal terminal segment is also referred to as the external calcarine sulcus.

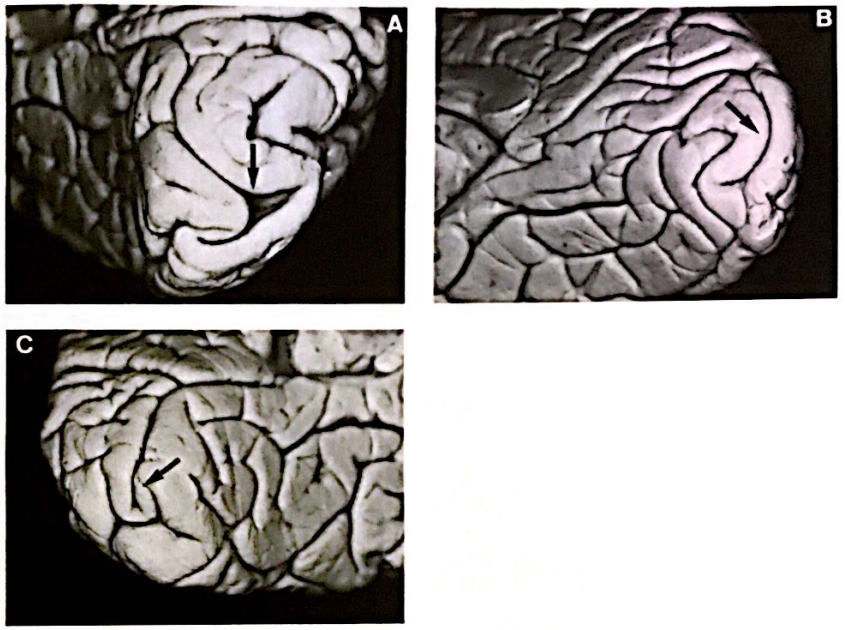
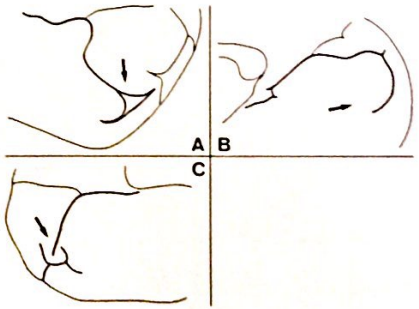


Figure 14.6
Calcarine sulcus: posterior end
(incidence rates in %)

I. Shape
  1. T or Y-shape (A)
     Right – 80%; left – 52%
  2. Single curve (B)
     Right – 12%; left – 24%
  3. Single straight (C)
     Right – 8%; left – 24%

II. Position of the posterior end
  1. Lateral surface (A,B)
     Right – 48%; left – 60%
  2. Medial surface
     Right – 20%; left – 20%
  3. Inferior surface (C)
     Right – 12%; left – 8%
  4. Medial and lateral surfaces
     Right – 20%; left – 8%
  5. Lateral and inferior surfaces
     Right 0%; left – 4%

Note: straight-end cases have a separate terminal segment in the form of either an extreme or an external calcarine sulcus.



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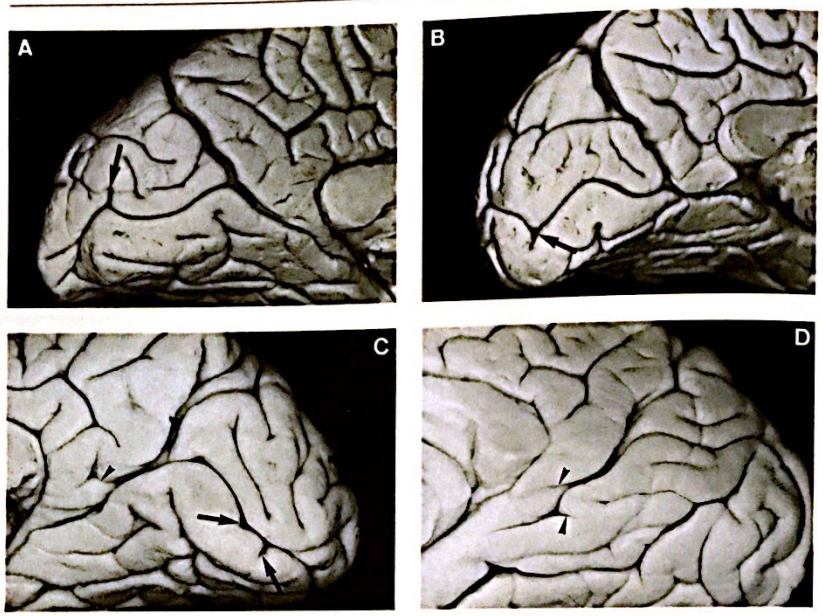


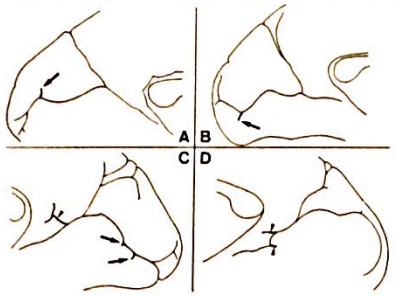


Figure 14.7
Calcarine sulcus: side branches
(incidence rates in %)

I. Side branches of the posterior segment
1. Directed superiorly over the cuneus (A)

Number	*Right*	*Left*
1(A)	20%	28%
2	4%	0%

2. Directed inferiorly over the lingual gyrus (B,C)

Number	*Right*	*Left*
1(B)	12%	12%
2(C)	4%	0%

3. Directed superiorly over the cuneus and inferiorly over the lingual gyrus

Number	*Right*	*Left*
2	8%	4%

II. Side branches of the anterior segment (arrowheads)
1. Directed anteriorly over the isthmus of the cingulate gyrus (C)

Number	*Right*	*Left*
1(C)	24%	28%
2	4%	0%

2. Directed posteriorly over the lingual gyrus

Number	*Right*	*Left*
1	0%	16%

3. Directed anteriorly over the isthmus of the cingulate gyrus and posteriorly over the lingual gyrus (D)

Number	*Right*	*Left*
2(D)	12%	4%

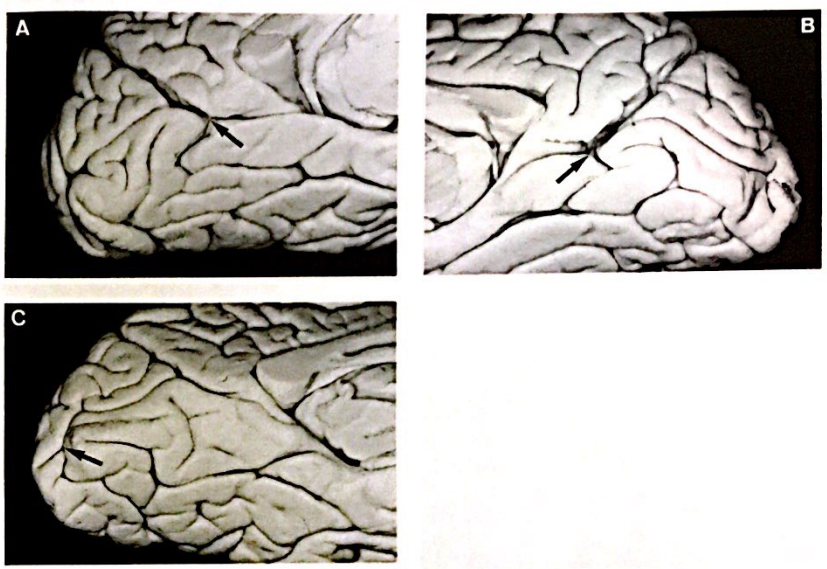
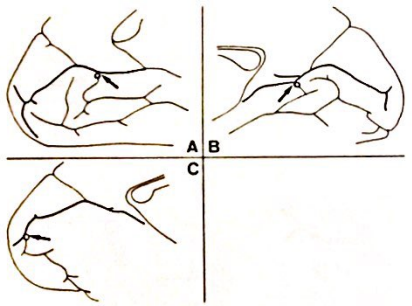


Figure 14.8
Calcarine sulcus: connections
(incidence rates in %)

Connections
1. Pseudoconnection with the collateral sulcus via the medial ramus (A,B)
Right – 12%; left – 4%
2. With the occipitotemporal sulcus (C)
Right – 0%; left – 4%



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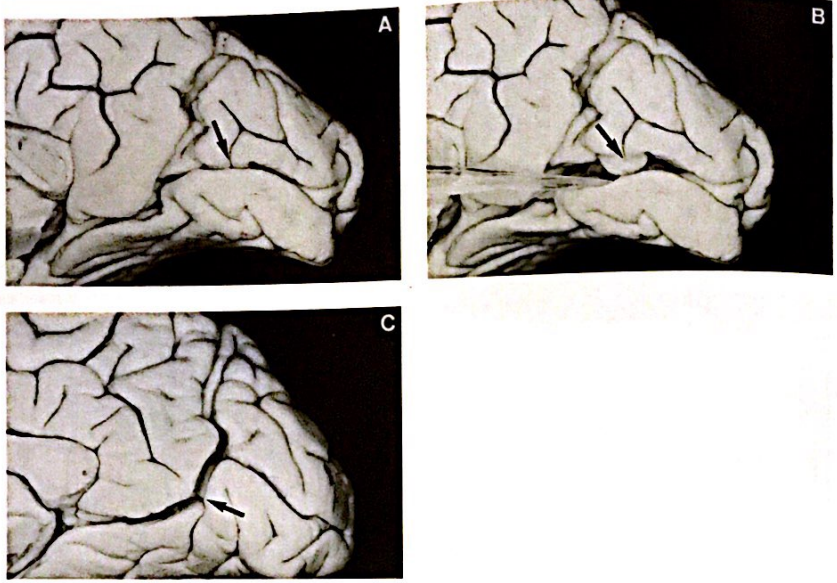


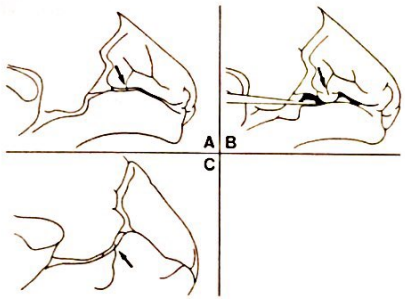


Figure 14.9
Calcarine sulcus: connections
(incidence rates in %)

Connections

3. Pseudoconnection with a sagittal sulcus of the cuneus (A=B)
   Right – 4%; left – 12%
4. Pseudoconnection with the intralingual sulcus – single (C)
   Right – 12%; left – 0%
5. Pseudoconnection with the intralingual sulcus – double
   Right – 8%; left – 0%

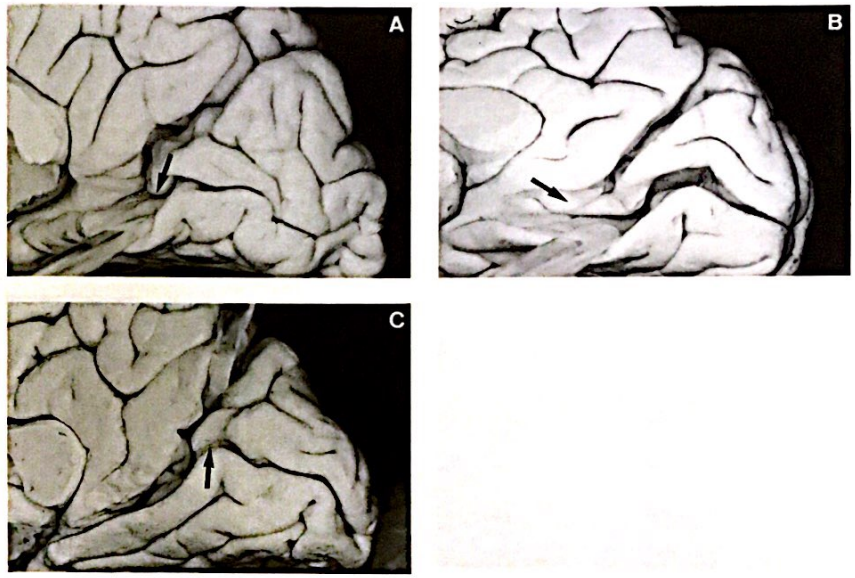
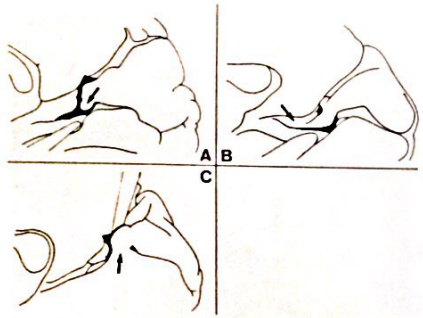


Figure 14.10
Calcarine sulcus: apex of the cuneus
(incidence rates in %)

Relationship of the calcarine sulcus to the apex of the cuneus

1. Apex of the cuneus with a blind end (A)
   Right – 52%; left – 44%
2. Apex of the cuneus connected to the isthmus of the cingulate gyrus (B)
   Right – 44%; left – 52%
3. Apex of the cuneus connected to the lingual gyrus (C)
   Right – 4%; left – 4%



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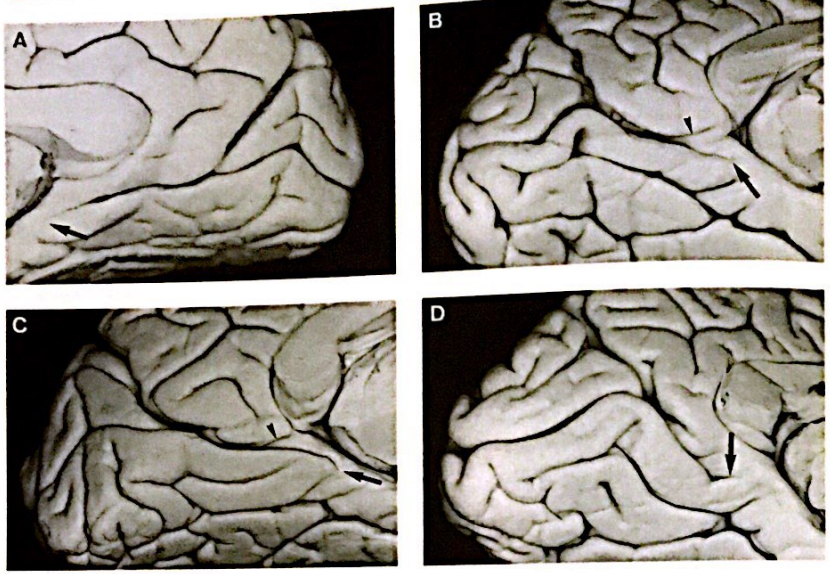


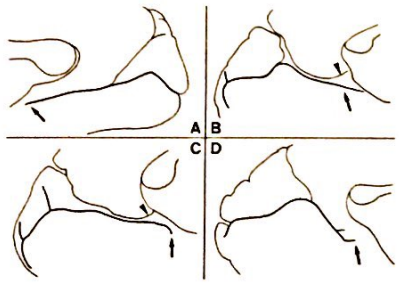
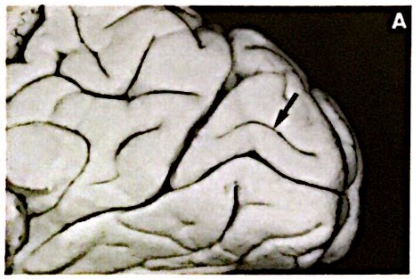
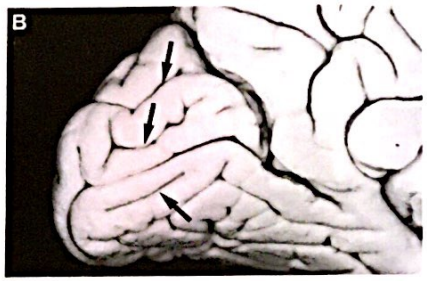


Figure 14.11
Calcarine sulcus: anterior end
(incidence rates in %)

Direction and shape
1. Straight (A,B)
   Right – 88%; left – 52%
2. Medially curved (D)
   Right – 12%; left – 12%
3. Laterally curved (C)
   Right – 0%; left – 36%
4. Infundibulum type (arrowheads) (B,C)
   Right – 40%; left – 60%





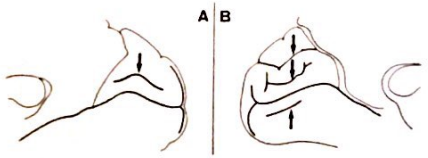


Figure 14.12
Calcarine sulcus: parallel sulci
(incidence rates in %)

I. Sulci of the cuneus
   1. Inferior sagittal sulcus (A)
      Right – 36%, left – 40%
   2. Inferior and superior sagittal sulci (B)
      Right – 12%, left – 4%
   3. Connection to the parieto-occipital sulcus (B)
      Right – 12%, left – 8%

II. Sulci of the lingual gyrus
   Intralingual sulcus (B)
   Right – 28%, left – 40%

III. Sulci of both the cuneus and the lingual gyri present
   Double parallel sulci (B)
   Right – 12%, left – 20%

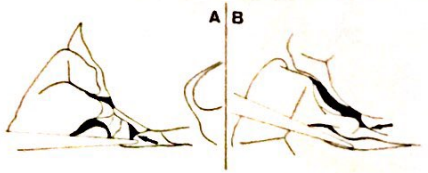


Figure 14.13
Parieto-occipital sulcus: inferior end
(incidence rates in %)

I. Inner pattern
   1. True connection with the calcarine sulcus (A)
      Right – 56%, left – 48%
   2. Pseudoconnection with the calcarine sulcus (B)
      Right – 44%; left – 52%

Note: the pseudoconnection to the calcarine sulcus is created by an intervention of the apex of the cuneus.

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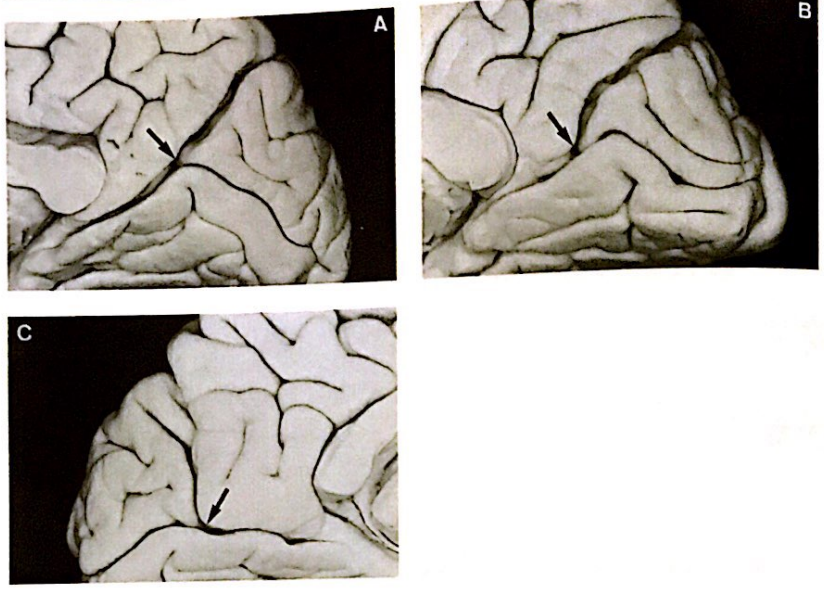


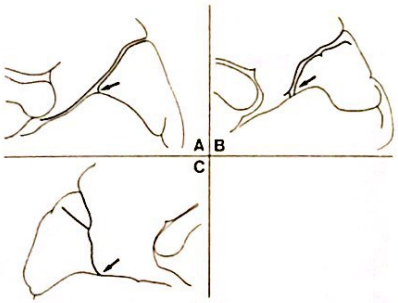


Figure 14.14
Parieto-occipital sulcus: inferior end
(incidence rates in %)

II. Location of the end-point
1. At the first peak of the calcarine sulcus (A)
Right – 68%; left – 68%
2. Anterior to the first peak of the calcarine sulcus (B)
Right – 32%; left – 28%
3. Posterior to the first peak of the calcarine sulcus (C)
Right – 0%; left – 4%

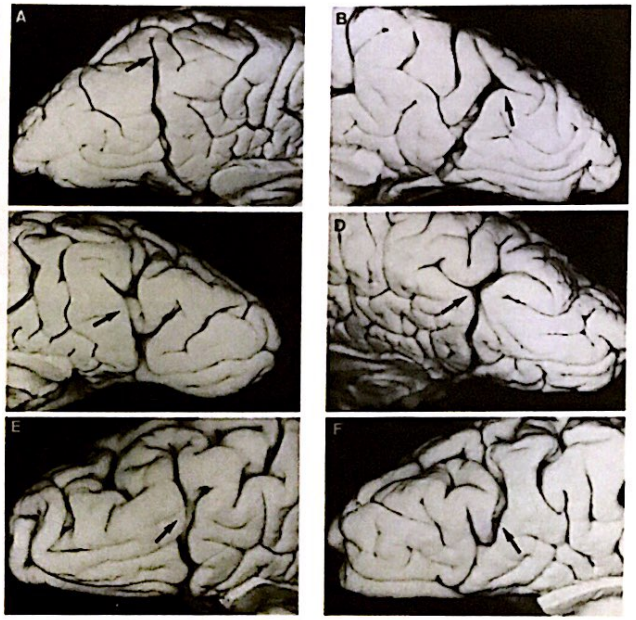
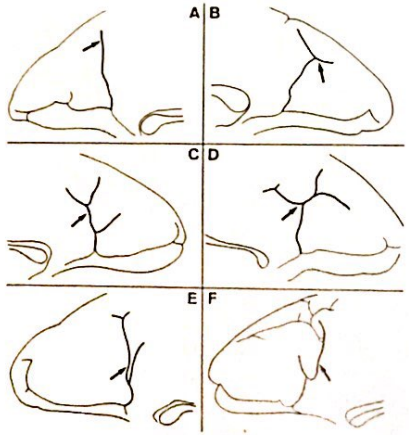


Figure 14.15
Parieto-occipital sulcus: patterns of the superior segment
(incidence rates in %)

I. Extension to the lateral surface
Right – 96%; left – 100%
II. Shape and side branches
1. Straight (A)
Right – 16%; left – 24%
2. T- or Y-shape (B)
Right – 24%; left – 24%
3. Ramified to three branches with inferior branch directed posteriorly (C)
Right – 40%; left – 16%
4. Ramified to three branches with inferior branch directed anteriorly (D)
Right – 8%; left – 4%
5. One anteriorly-directed large side branch present (E)
Right – 4%; left – 8%
6. One posteriorly-directed large side branch present (F)
Right – 8%; left – 8%



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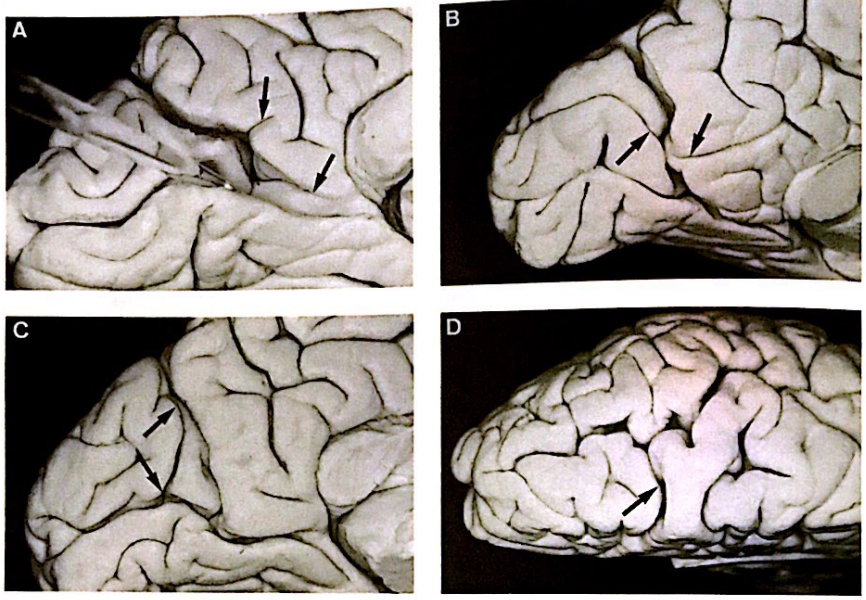

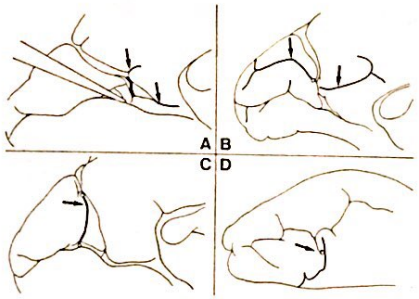

Figure 14.**16**
Parieto-occipital sulcus: side branches and connections
(incidence rates in %)

I. Side Branches
   1. Directed toward the precuneus (A)
      Right – 32%; left – 40%
   2. Directed toward the isthmus of the cingulate gyrus (A)
      Right – 8%; left – 32%

II. Connections
   1. With a sagittal sulcus of the cuneus (B)
      Right – 36%; left – 48%
   2. With a vertical sulcus of the cuneus (C)
      Right – 28%; left – 12%
   3. With the intraparietal sulcus (D)
      Right – 16%; left – 28%

5

The Sylvian Fissure

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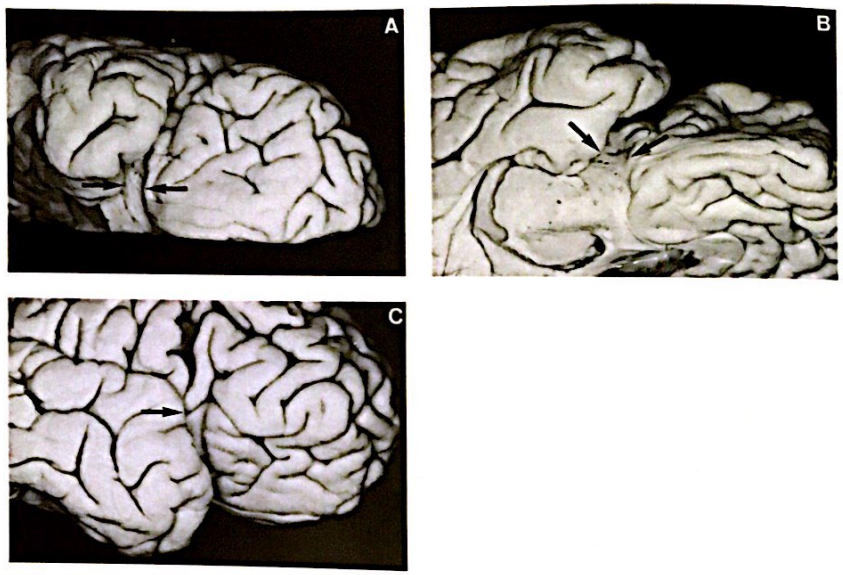
Chapter 15
Sylvian Fissure



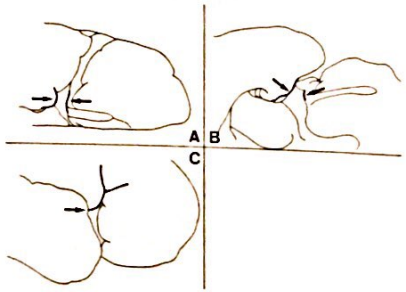


Figure 15.1
Sylvian fissure: stem
(incidence rates in %)

I. Medial end: defined by a line drawn between the lateral olfactory striae and the ambient gyrus (A,B)

II. Lateral end
1. Origin of the horizontal ramus
Right – 76%; left – 60%
2. Origin of the common trunk of the horizontal and ascending rami (C)
Right – 28%; left – 24%
3. Origin of the ascending ramus (no horizontal ramus present)
Right – 4%; left – 16%

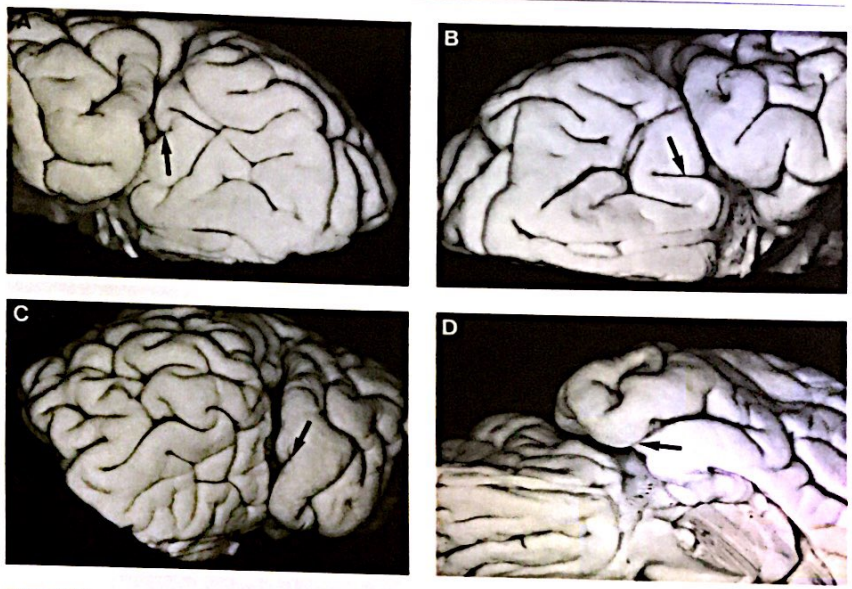
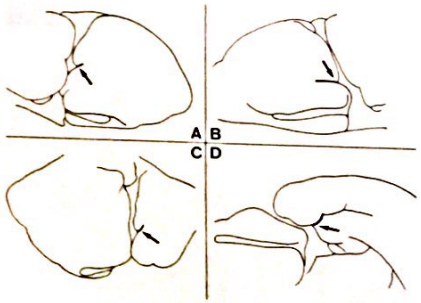


Figure 15.2
Sylvian fissure: stem side branches and connections
(incidence rates in %)

I. Side branch to the orbital gyrus
1. At the end of the pars orbitalis (A)
Right – 56%; left – 52%
2. Medial to the end of the pars orbitalis (B)
Right – 0%; left – 8%

II. Side branch to the temporal tip
1. Lateral (C)
Right – 36%; left – 16%
2. Medial (D)
Right – 32%; left – 28%
3. Lateral and medial
Right – 24%; left – 48%
4. None present
Right – 8%; left – 8%

III. Pseudoconnection with the orbital sulcus
1. With a lateral posteriorly-directed side branch of the orbital sulcus (see Fig. 11.4B)
Right – 8%; left – 16%
2. With a medial posteriorly-directed side branch of the orbital sulcus
Right – 4%; left – 8%



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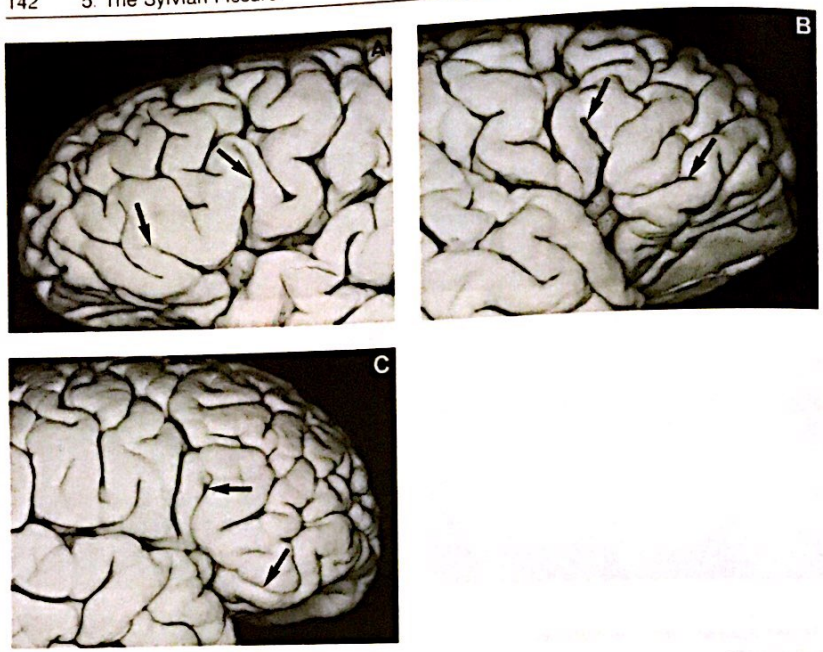


Figure 15.3
Sylvian fissure: horizontal ramus patterns
(incidence rates in %)

Surface Position
1. Over the lateral surface (A)
   Right – 44%; left – 28%
2. Along the orbital margin (B)
   Right – 16%; left – 32%
3. Over the orbital surface (C)
   Right – 28%; left – 24%
4. None present
   Right – 8%; left – 16%

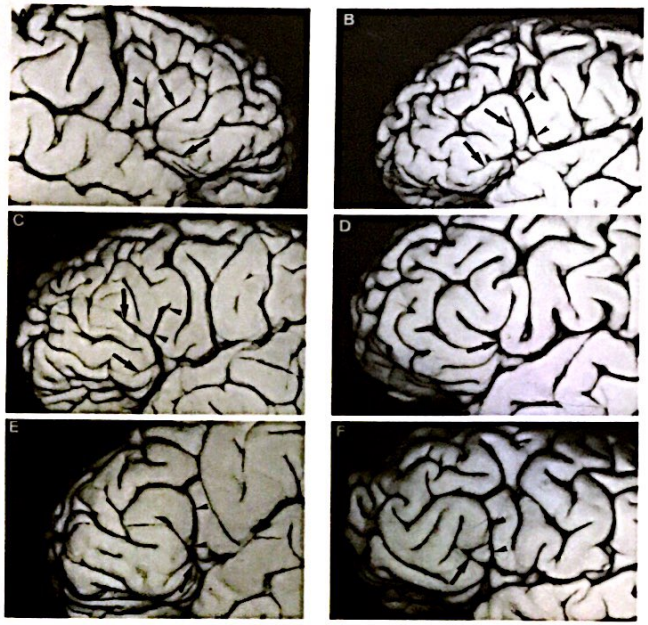
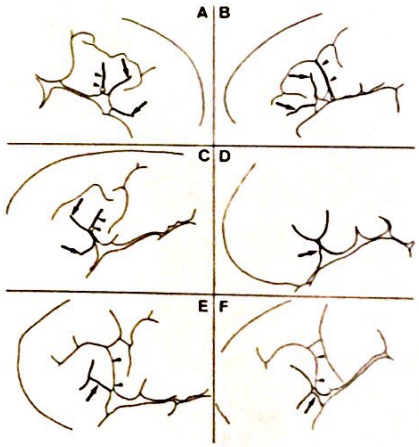


Figure 15.4
Sylvian Fissure: horizontal ramus, ascending ramus and diagonal sulcus patterns and connections
(incidence rates in %)

I. Patterns of the horizontal and ascending rami
   1. Separate horizontal and ascending rami (A–C)
      Right – 64%; left – 60%
   2. Common trunk for the horizontal and ascending rami (D–F)
      Right – 28%; left – 24%

II. Patterns of the diagonal sulcus (arrowheads)
   1. None present (D)
      Right – 36%; left – 28%
   2. Pseudoconnection with the Sylvian fissure
      Right – 64%; left – 64%
   3. True connection with the Sylvian fissure
      Right – 0%; left – 8%

III. Connections of the diagonal sulcus
   1. With the posterior ramus (A,B)
      Right – 64%; left – 36%
   2. With the ascending ramus (C)
      Right – 0%; left – 24%
   3. With the common trunk of the horizontal and ascending rami (F)
      Right – 0%; left – 4%



   4. With the inferior frontal sulcus (B,E)
      Right – 4%; left – 24%
   5. With the inferior precentral sulcus (see Fig 15.5B)
      Right – 0%; left – 4%

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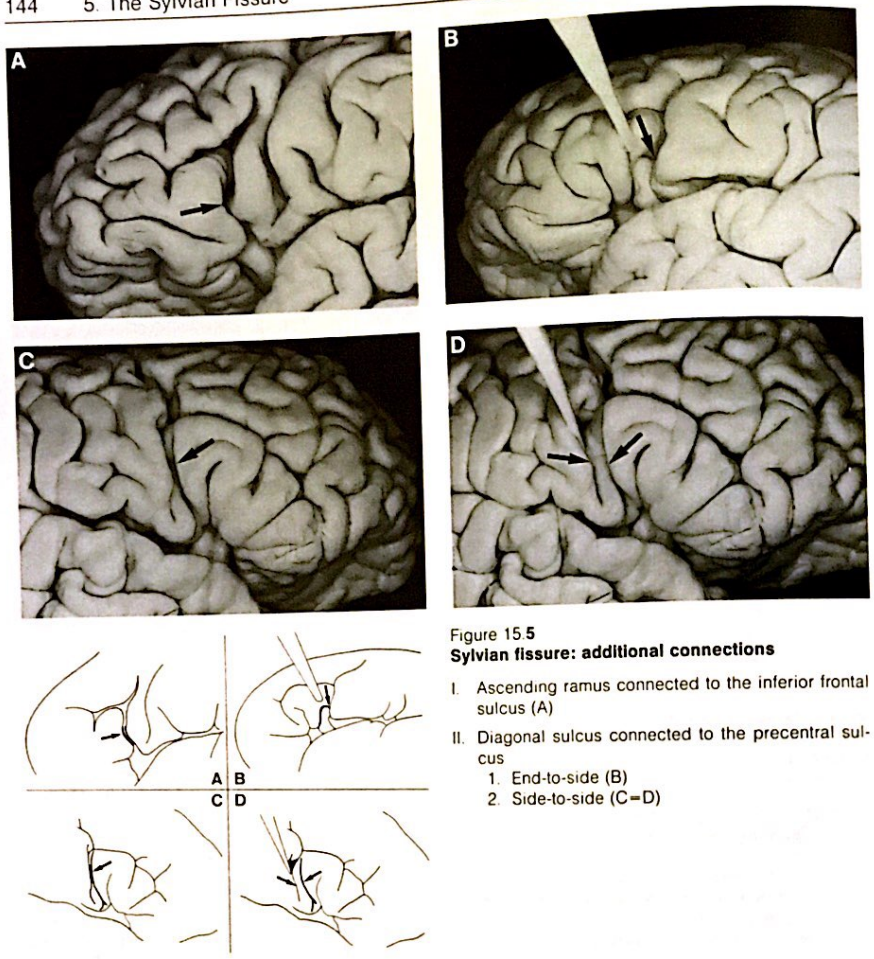


Figure 15.5
Sylvian fissure: additional connections

I. Ascending ramus connected to the inferior frontal sulcus (A)

II. Diagonal sulcus connected to the precentral sulcus
   1. End-to-side (B)
   2. Side-to-side (C=D)

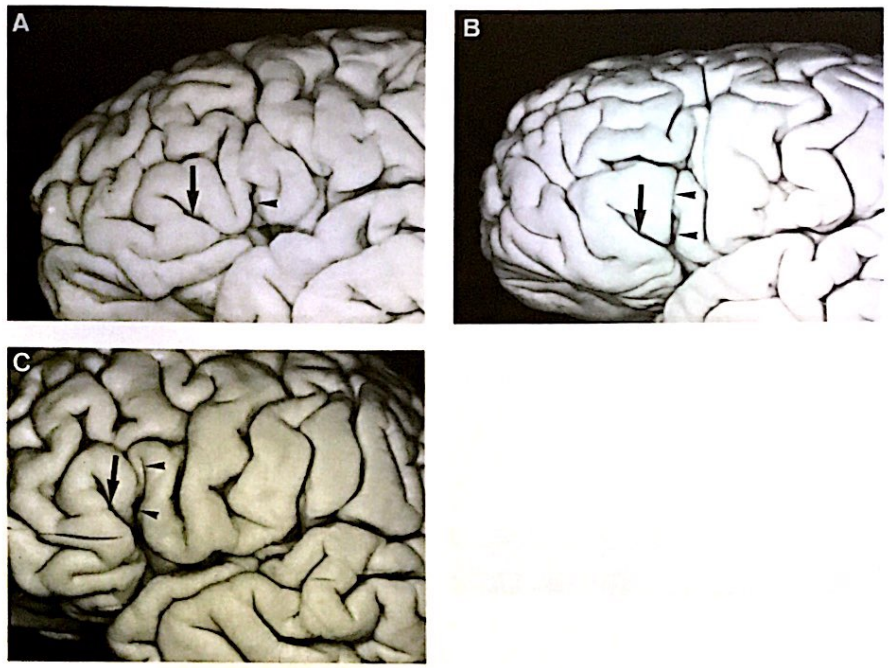
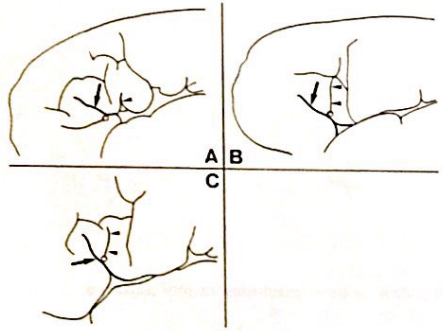


Figure 15.6
Sylvian fissure: absence of the horizontal ramus
(incidence rates in %)

Patterns in the absence of the horizontal ramus
1. Ascending ramus, with diagonal sulcus (B)
   Right – 4%; left – 4%
2. Ascending ramus, with a free sulcus (C)
   Right – 4%; left – 0%
3. Ascending ramus, with diagonal sulcus and fronto-orbital sulcus (A)
   Right – 0%; left – 12%



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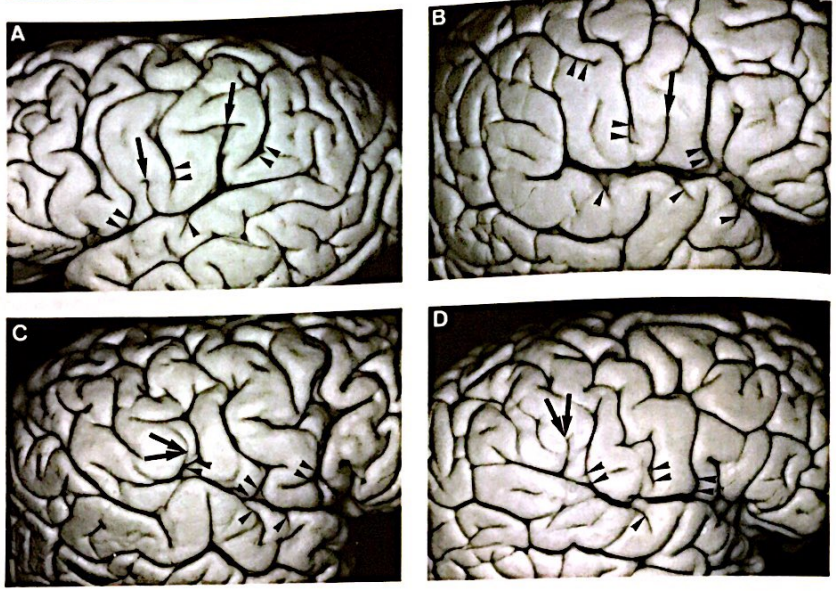


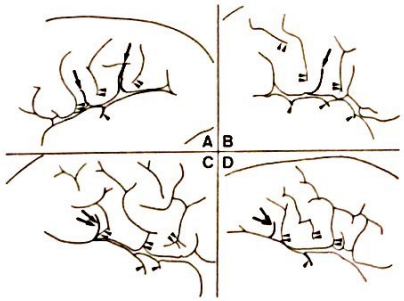


Figure 15.7
Sylvian fissure: posterior ramus patterns
(incidence rates in %)

I. Definition. The posterior ramus is the segment of the Sylvian fissure between the ascending ramus and the terminal ascending segment.

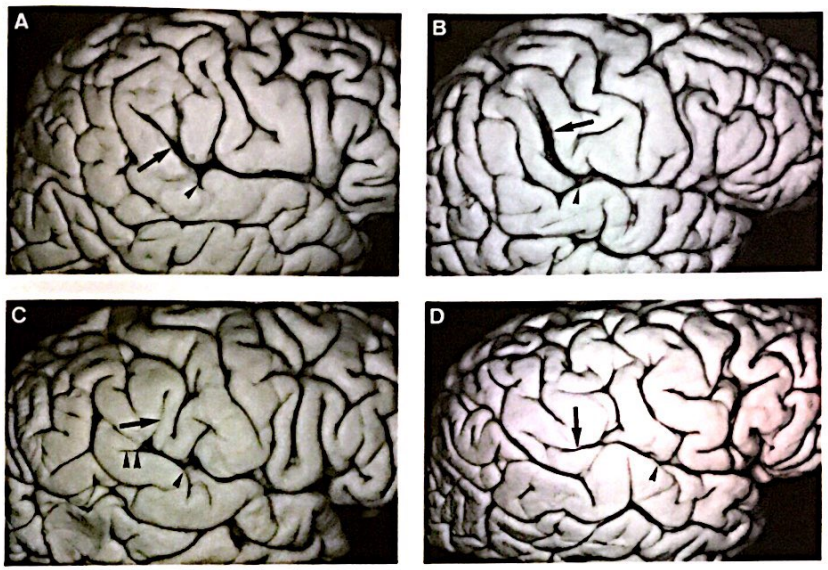
II. Relationship to the precentral, central, and postcentral sulci (double arrowheads)
   1. Precentral sulcus extends into the Sylvian fissure (A,D)
      Right – 28%, left – 16%
   2. Central sulcus extends into the Sylvian fissure (C)
      Right – 16%; left – 12%
   3. Postcentral sulcus extends into the Sylvian fissure (C,D)
      Right – 68%; left – 40%

III. Anterior subcentral sulcus (single arrows)
   1. True connection with the Sylvian fissure
      Right – 24%; left – 12%
   2. Pseudoconnection with the Sylvian fissure (A,B)
      Right – 48%; left – 48%

IV. Posterior subcentral sulcus (single arrows)
   1. True connection with the Sylvian fissure (A)
      Right – 56%; left – 88%
   2. Pseudoconnection with the Sylvian fissure
      Right – 0%; left – 4%

V. Transverse temporal sulcus (single arrowheads)
   1. Anterior (B)
      Right – 16%; left – 28%
   2. Intermediate (B,C)
      Right – 68%; left – 76%
   3. Posterior (A–D)
      Right – 68%; left – 72%

VI. Additional superiorly-directed side branches from the ascending terminal segment (C,D, double arrows)
      Right – 12%; left – 16%



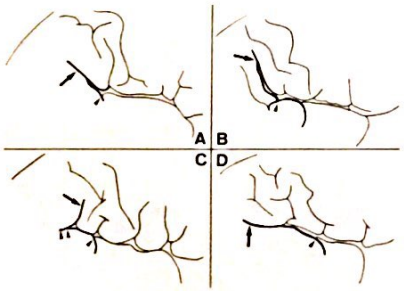


Figure 15.8
Sylvian fissure: terminal ascending segment, right side
(incidence rates in %)

I. Vertical type
   1. With a descending terminal portion which constitutes the posterior transverse temporal sulcus (A,B, single arrowheads) 68%
   2. Presence of a double parallel terminal ascending segment (B) 4%
   3. With a descending terminal portion which does not constitute the posterior transverse temporal sulcus (C, double arrowheads) 24%

II. Horizontal type
   1. With a ramified end 4%
   2. With a simple end (D) 4%

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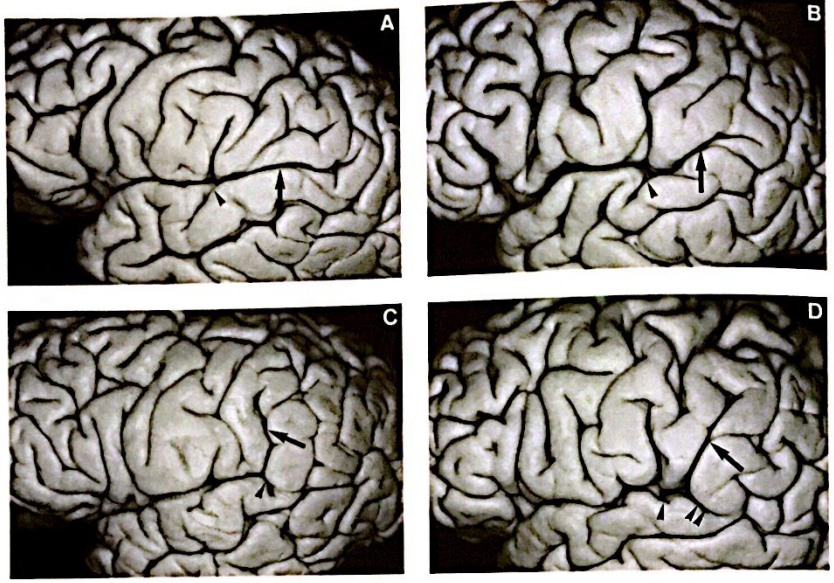


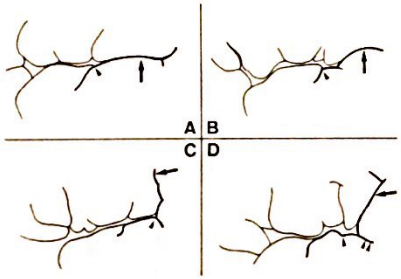


Figure 15.9
Sylvian fissure: terminal ascending segment, left side
(incidence rates in %)

I. Vertical type
   1. With a descending terminal portion which constitutes the posterior transverse temporal sulcus (C, single arrowhead) 40%
   2. With a descending terminal portion which does not constitute the posterior transverse temporal sulcus (D, double arrowheads) 4%

II. Horizontal type
   1. With a ramified end (A) 48%
   2. With a simple end (B) 8%

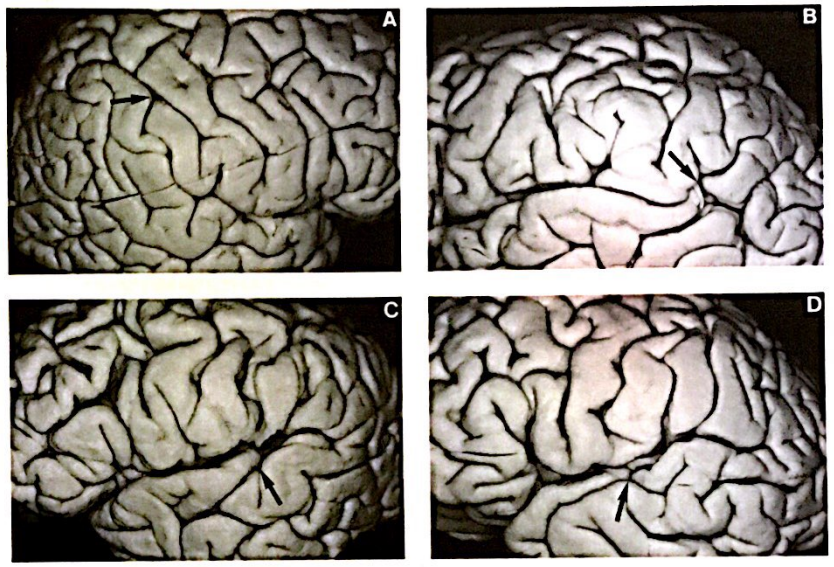
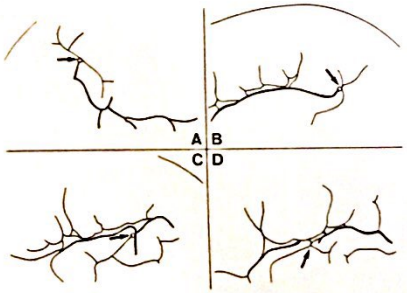


Figure 15.10
Sylvian fissure: connections
(incidence rates in %)

Connections
1. With the postcentral sulcus via the terminal ascending segment (A)
   Right – 4%; left – 0%
2. With the superior temporal sulcus via a descending terminal branch (B)
   Right – 4%; left – 12%
3. With the superior temporal sulcus via the transverse temporal sulcus (C)
   Right – 0%; left – 12%
4. With the superior temporal sulcus via the horizontal segment of the posterior ramus (D)
   Right – 0%; left – 12%



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6

Measurements

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Chapter 16
Sulcal and Intersulcal Measurements

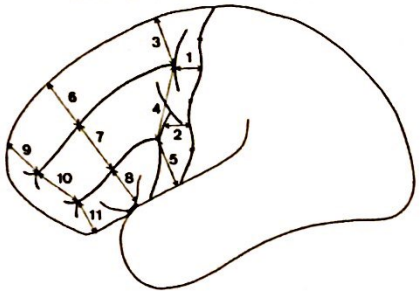

Figure 16.1
Lateral surface: frontal lobe
(measurements in mm)

	R	L
I. Sulcal length: average (range)		
Central sulcus	105 (88–127)	94 (70–125)
Superior frontal sulcus	80 (48– 98)	97 (78–116)
Inferior frontal sulcus	41 (29– 60)	36 (21– 42)
II. Intersulcal distance: average (range)		
2. Central sulcus → superior precentral sulcus	13 (9– 12)	13 (8– 19)
2. Central sulcus → inferior precentral sulcus	14 (6– 22)	14 (6– 24)
3. Superior margin → superior frontal sulcus	26 (22– 37)	24 (17– 32)
4. Superior frontal sulcus → inferior frontal sulcus	36 (24– 51)	37 (26– 65)
5. Inferior frontal sulcus → Sylvian fissure	30 (20– 40)	30 (15– 40)
6. Superior margin → superior frontal sulcus	24 (8– 33)	23 (19– 27)
7. Superior frontal sulcus → inferior frontal sulcus	32 (2– 44)	32 (20– 44)
8. Inferior frontal sulcus → ascending ramus	27 (15– 33)	29 (20– 40)
9. Superior margin → superior frontal sulcus	19 (10– 30)	23 (12– 33)
10. Superior frontal sulcus → inferior frontal sulcus	32 (12– 43)	26 (14– 47)
11. Inferior frontal sulcus → orbital margin	26 (13– 40)	27 (15– 41)

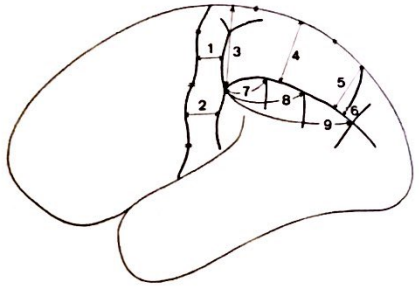

Figure 16.2
Lateral surface: parietal and occipital lobes
(measurements in mm)

	R	L
I. Sulcal length: average (range)		
Postcentral sulcus	89 (70–103)	94 (70–125)
Intraparietal sulcus	73 (50–108)	76 (57–102)
II. Intersulcal distance: average (range)		
1. Central sulcus → postcentral sulcus	11 (4– 17)	12 (6– 19)
2. Central sulcus → postcentral sulcus	10 (6– 19)	12 (5– 23)
3. Superior margin → intraparietal sulcus	40 (30– 55)	41 (19– 56)
4. Superior margin → intraparietal sulcus	30 (20– 42)	33 (20– 41)
5. Superior margin → intraparietal sulcus	27 (12– 38)	25 (18– 33)
6. Parieto-occipital sulcus → intraparietal sulcus	6 (0– 18)	4 (0– 10)
7. Postcentral sulcus → primary intermediate sulcus	14 (6– 22)	14 (4– 32)
8. Postcentral sulcus → secondary intermediate sulcus	24 (11– 36)	33 (14– 51)
9. Postcentral sulcus → transverse parietal sulcus	60 (49– 82)	76 (57–102)

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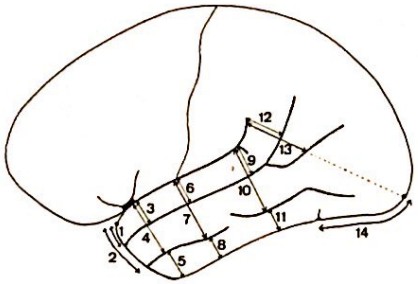

Figure 16.3
Lateral surface: temporal lobe
(measurements in mm)

	R	L
I. Sulcal length: average (range)		
Superior temporal sulcus	145 (118–169)	139 (128–154)
II. Intersulcal distance: average (range)		
1. Temporal pole → superior temporal sulcus	10 (4– 18)	13 (6– 20)
2. Temporal pole → inferior temporal sulcus	25 (18– 34)	24 (13– 34)
3. Sylvian fissure → superior temporal sulcus	13 (8– 21)	13 (7– 25)
4. Sylvian fissure → inferior temporal sulcus	29 (21– 34)	30 (22– 39)
5. Inferior temporal sulcus → inferior margin	8 (3– 16)	8 (0– 23)
6. Sylvian fissure → superior temporal sulcus	14 (7– 19)	12 (4– 26)
7. Sylvian fissure → inferior temporal sulcus	31 (24– 41)	31 (4– 36)
8. Inferior temporal sulcus → inferior margin	7 (3– 15)	8 (0– 36)
9. Sylvian fissure → superior temporal sulcus	16 (10– 28)	13 (7– 27)
10. Sylvian fissure → inferior temporal sulcus	32 (21– 45)	32 (11– 40)
11. Inferior temporal sulcus → inferior margin	9 (0– 17)	8 (5– 22)
12. Sylvian fissure → angular sulcus	20 (5– 44)	22 (9– 40)
13. Sylvian fissure → anterior occipital sulcus	35 (22– 50)	33 (20– 45)
14. Occipital pole → preoccipital notch	53 (39– 66)	56 (42– 74)

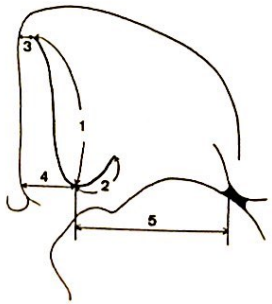

Figure 16.4
Inferior surface: frontal lobe
(measurements in mm)

	R	L
I. Sulcal length: average (range)		
1. Olfactory sulcus	44 (37–58)	44 (37–51)
2. Olfactory sulcus (lateral extension)	15 (6–25)	10 (3–26)
II. Intersulcal distance: average (range)		
3. Medial margin → olfactory sulcus	3 (0– 8)	3 (0– 7)
4. Medial margin → olfactory sulcus	7 (5–11)	8 (3–10)
5. Olfactory sulcus → horizontal ramus	38 (32–58)	39 (22–48)

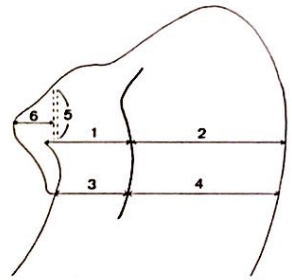

Figure 16.5
Inferior surface: temporal lobe
(measurements in mm)

	R	L
I. Sulcal length: average (range)		
Rhinal sulcus	31 (15–56)	31 (21–52)
II. Intersulcal distance: average (range)		
1. Hippocampal sulcus → rhinal sulcus	17 (12–22)	16 (16–22)
2. Rhinal sulcus → inferior margin	30 (23–39)	28 (21–37)
3. Hippocampal sulcus → rhinal sulcus	9 (6–26)	12 (7–19)
4. Rhinal sulcus → inferior margin	30 (15–56)	32 (21–52)
III. Groove made by the tentorial edge: average (range)		
5. Groove length	9 (6–14)	9 (4–15)
6. Uncus tip → tentorial groove	4 (2– 5)	3 (1– 5)

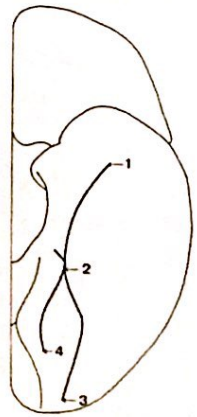

Figure 16.6
Inferior surface: temporal and occipital lobes
(measurements in mm)

	R	L
I. Sulcal length average (range)		
1 – 3 Collateral sulcus	85 (62–111)	83 (48–104)
2 – 4 Intralingual sulcus	26 (9– 44)	35 (15– 50)
II. Division of the collateral sulcus average (range)		
1 – 2 Anterior end → bifurcation point	39 (18– 56)	36 (18– 56)
2 – 3 Bifurcation point → posterior end	44 (22– 62)	47 (24– 70)

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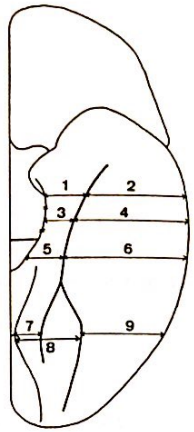

Figure 16.7
Inferior surface: temporal and occipital lobes
(measurements in mm)

Intersulcal distance average (range)	R	L
1. Medial margin →collateral sulcus	16 (10–22)	19 (13–28)
2. Collateral sulcus → inferior margin	28 (21–36)	23 (16–34)
3. Medial margin → collateral sulcus	11 (4–14)	13 (8–23)
4. Collateral sulcus → inferior margin	37 (31–47)	34 (23–42)
5. Medial margin → collateral sulcus	21 (13–27)	21 (13–28)
6. Collateral sulcus → inferior margin	37 (30–44)	37 (33–48)
7. Calcarine sulcus → intralingual sulcus	15 (12–18)	15 (5–24)
8. Calcarine sulcus → collateral sulcus	29 (17–37)	29 (17–39)
9. Collateral sulcus → inferior margin	28 (21–40)	27 (17–39)

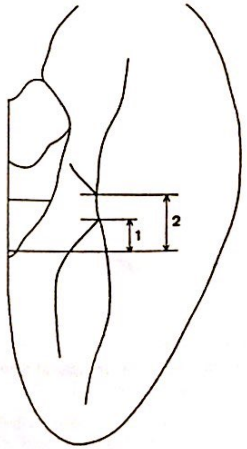

Figure 16.8
Inferior surface: temporal and occipital lobes
(measurements in mm)

Division of the collateral sulcus: average (range)	R	L
1. Splenium → bifurcation point	1 (5– 6)	2 (8–10)
2. Splenium → parahippocampal ramus	8 (3–17)	5 (8–15)

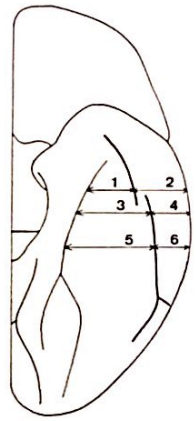

Figure 16.9
Inferior surface: temporal and occipital lobes
(measurements in mm)

I. Sulcal length: average (range)	R	L
Occipitotemporal sulcus	90 (67–123)	95 (71–115)
II. Intersulcal distance: average (range)		
1. Medial margin → occipitotemporal sulcus	12 (1– 24)	8 (0– 17)
2. Occipitotemporal sulcus → inferior margin	16 (8– 21)	16 (8– 22)
3. Medial margin → occipitotemporal sulcus	23 (8– 35)	18 (9– 30)
4. Occipitotemporal sulcus → inferior margin	15 (8– 22)	16 (5– 31)
5. Medial margin → occipitotemporal sulcus	27 (11– 32)	25 (12– 36)
6. Occipitotemporal sulcus → inferior margin	10 (4– 21)	13 (4– 20)

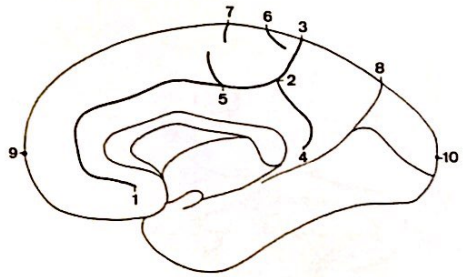

Figure 16.10
Medial surface: frontal and parietal lobes
(measurements in mm)

I. Sulcal length: average (range)	R	L
1.– 3. Cingulate sulcus	145 (114–165)	148 (125–175)
1.– 2. Cingulate sulcus → marginal ramus	123 (100–145)	132 (108–150)
2.– 3. Marginal ramus	24 (15– 42)	27 (18– 34)
2.– 4. Subparietal sulcus	39 (24– 54)	36 (29– 44)
3.– 5. Marginal ramus → paracentral sulcus	52 (36– 71)	51 (38– 64)
II. Intersulcal distance: average (range)		
3 – 6. Marginal ramus → central sulcus	15 (4– 24)	17 (5– 25)
3 – 7. Marginal ramus → precentral sulcus	34 (22– 41)	30 (19– 41)
3.– 8. Marginal ramus → parieto-occipital sulcus	40 (26– 54)	38 (26– 49)
3 – 9. Marginal ramus → frontal pole	138 (110–160)	142 (122–160)
3.–10. Marginal ramus → occipital pole	88 (69–110)	80 (71– 93)

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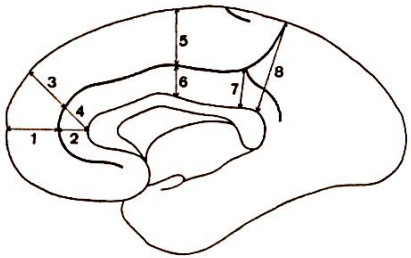

Figure 16.**11**
Medial surface: frontal and parietal lobes
(measurements in mm)

		R	L
Intersulcal distance: average (range)			
1.	Superior margin → cingulate sulcus	24 (28–37)	23 (17–29)
2.	Cingulate sulcus → corpus callosum (genu)	10 (5–16)	12 (7–19)
1.–2.	Superior margin → corpus callosum (genu)	34 (28–37)	35 (30–38)
3.	Superior margin → cingulate sulcus	22 (17–31)	21 (13–27)
4.	Cingulate sulcus → corpus callosum (genu)	13 (5–19)	14 (10–19)
3.–4.	Superior margin → corpus callosum (genu)	35 (32–40)	35 (30–40)
5.	Superior margin → cingulate sulcus	21 (12–29)	25 (15–33)
6.	Cingulate sulcus → corpus callosum (body)	14 (7–25)	12 (8–20)
5.–6.	Superior margin → corpus callosum (body)	36 (32–40)	36 (31–44)
7.	Marginal ramus → corpus callosum (splenium)	16 (12–22)	18 (14–21)
8.	Superior margin → corpus callosum (splenium)	42 (33–47)	41 (31–48)

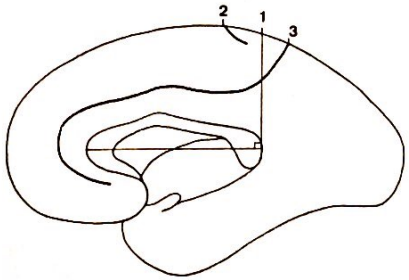

Figure 16.**12**
Medial surface: frontal and parietal lobes
(measurements in mm)

		R	L
Intersulcal distance: average (range)			
1.–2.	Splenial perpendicular → central sulcus	13 (4–27)	12 (0–25)
1.–3.	Splenial perpendicular → marginal ramus	5 (0–16)	6 (0–14)

Note: number 1 represents the perpendicular projection of the splenium onto the superior margin of the hemisphere.

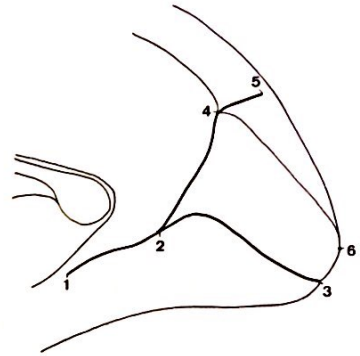

Figure 16.**13**
Medial surface: occipital lobe
(measurements in mm)

		R	L
I.	Sulcal length: average (range)		
1.–3.	Calcarine sulcus	85 (73–103)	83 (72–95)
2.–5.	Parieto-occipital sulcus	52 (28– 76)	54 (27–75)
II.	Divisions of the calcarine sulcus: average (range)		
1.–2.	Anterior segment	35 (20– 46)	30 (18–43)
2.–3.	Posterior segment	50 (32– 65)	53 (31–69)
III.	Divisions of the parieto-occipital sulcus: average (range)		
2.–4.	Medial surface	33 (28– 47)	34 (27–45)
4.–5.	Convex surface	19 (0– 29)	20 (8–30)
4.–6.	Parieto-occipital sulcus → occipital pole	49 (34– 59)	49 (40–59)

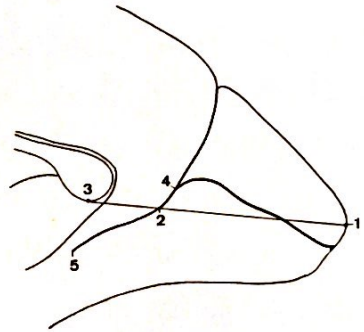

Figure 16.**14**
Medial surface: occipital lobe
(measurements in mm)

		R	L
Intersulcal distance: (average and range)			
1.–2.	Occipital pole → calcarine sulcus	44 (33–53)	42 (27–52)
2.–3.	Calcarine sulcus → splenium	15 (7–20)	16 (10–25)
1.–3.	Occipital pole → splenium	59 (51–70)	58 (45–67)
2.–4.		5 (7–14)	3 (4– 7)
2.–5.		31 (21–45)	28 (18–40)

Note: 2 = the crossing point of the occipito-slenial line upon the calcarine sulcus; 4 = the junction of the parieto-occipital and calcarine sulci; 5 = the anterior end of the calcarine sulcus

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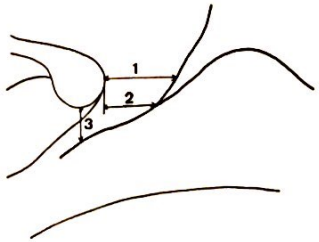

Figure 16.**15**
Medial surface: occipital lobe
(measurements in mm)

	R	L
Intersulcal distance: average (range)		
1. Splenium → parieto-occipital sulcus	16 (9–25)	17 (10–30)
2. Splenium → calcarine/parieto-occipital juncture	17 (10–26)	18 (10–30)
3. Splenium → anterior calcarine sulcus	6 (0–12)	6 (0–15)

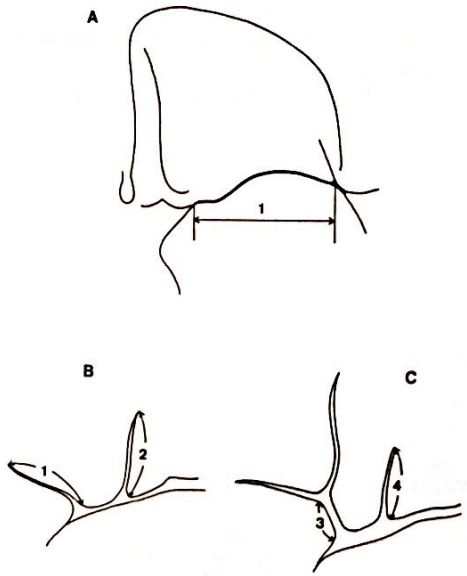

Figure 16.**16**
Sylvian fissure
(measurements in mm)

	R	L
Lengths: average (range)		
A–1. Stem	44 (31–62)	40 (28–53)
B–1. Horizontal ramus	15 (2–35)	14 (9–27)
B–2. Ascending ramus	16 (2–27)	18 (3–29)
C–3. Common stem of 1 and 2	8 (4–30)	9 (5–15)
C–4. Diagonal sulcus	19 (40–30)	17 (2–32)

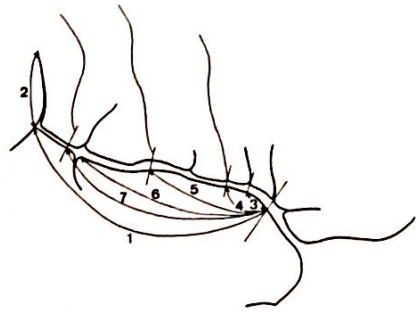

Figure 16.**17**
Sylvian fissure
(measurements in mm)

	R	L
I. Length of the posterior ramus: average (range)		
1. Horizontal segment	77 (59–95)	81 (62–97)
2. Terminal segment	20 (7–34)	21 (8–43)
II. Intersulcal distance: average (range)		
3. Ascending ramus → diagonal sulcus	8 (2–15)	9 (4–13)
4. Ascending ramus → precentral sulcus	14 (4–22)	16 (6–23)
5. Ascending ramus → central sulcus	32 (19–44)	29 (19–40)
6. Ascending ramus → transverse temporal sulcus	51 (33–68)	49 (37–60)
7. Ascending ramus → postcentral sulcus	54 (33–68)	50 (31–67)

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7

Brain sections

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Chapter 17
Coronal Sections

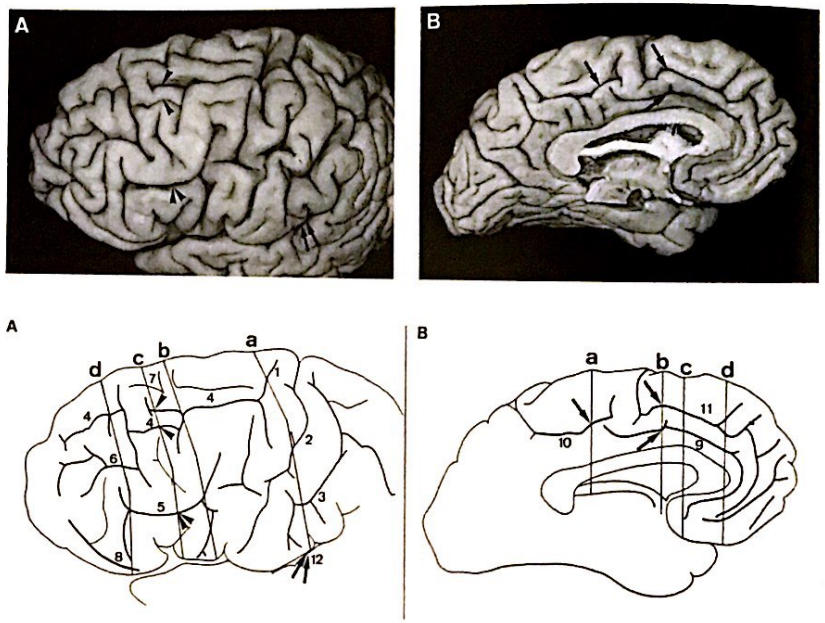


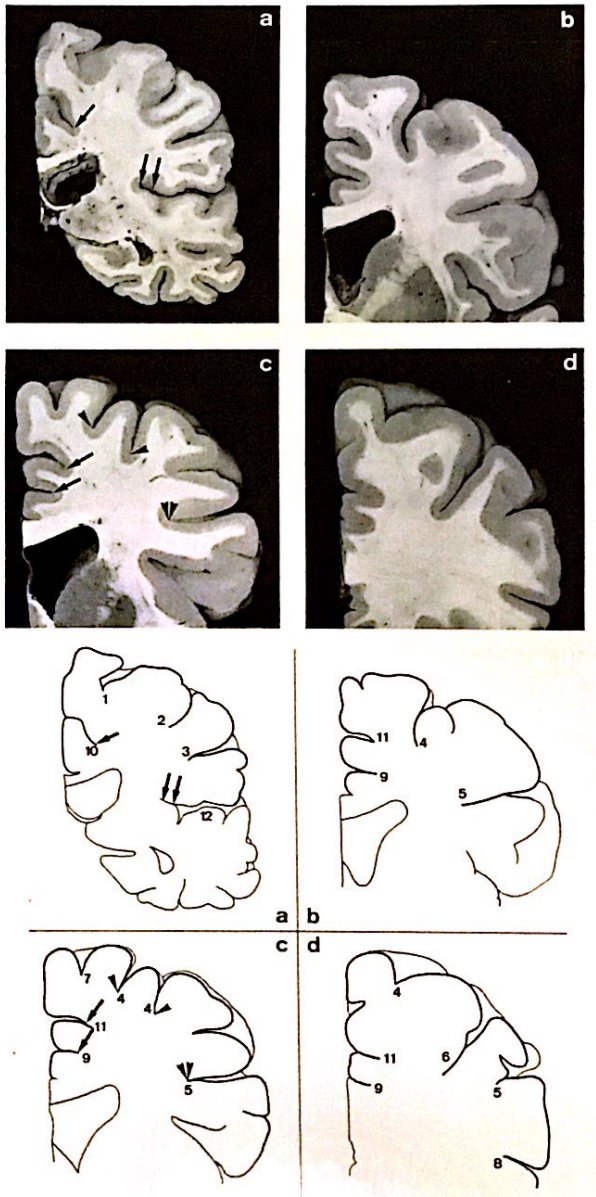
Figure 17.1
Coronal sections: frontal lobe

A Lateral surface
B Medial surface

Pattern of the sulci (A, B, Place of sections a–d)
1. Superior precentral sulcus
2. Central sulcus
3. Postcentral sulcus
4. Superior frontal sulcus
5. Inferior frontal sulcus
6. Intermediate frontal sulcus
7. Medial frontal sulcus
8. Fronto-orbital sulcus
9. Cingulate sulcus – anterior segment
10. Cingulate sulcus – superior segment of double sulci type
11. Cingulate sulcus – posterior segment
12. Sylvian fissure

Note: section **a** displays the proximity of the Sylvian fissure (double arrows) and the cingulate sulcus (single arrows) to the body of the lateral ventricle. Section **c** displays an overlapping superior frontal sulcus (single arrowheads) and inferior frontal sulcus (double arrowheads). A double parallel cingulate sulcus is also present (single arrows).

Figure 17.1



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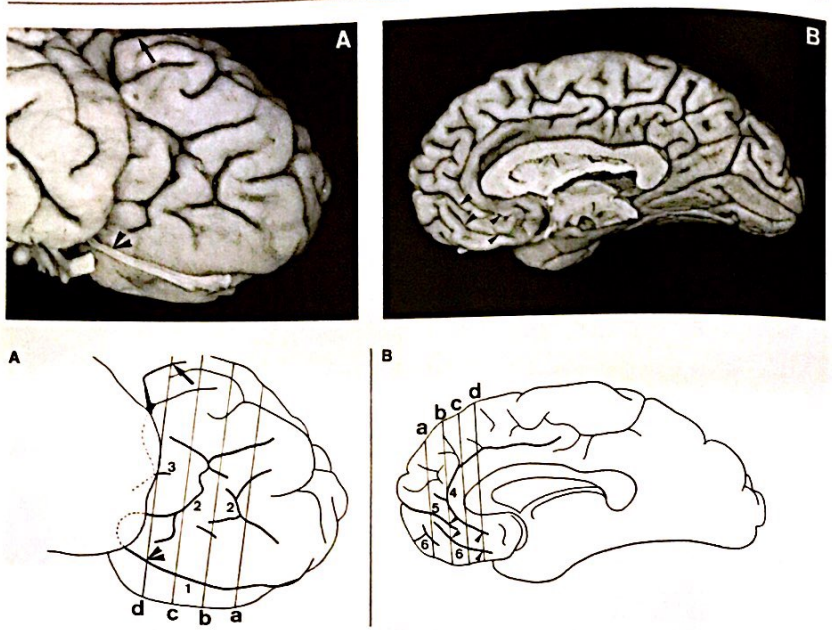


Figure 17.2
Coronal sections: frontal lobe

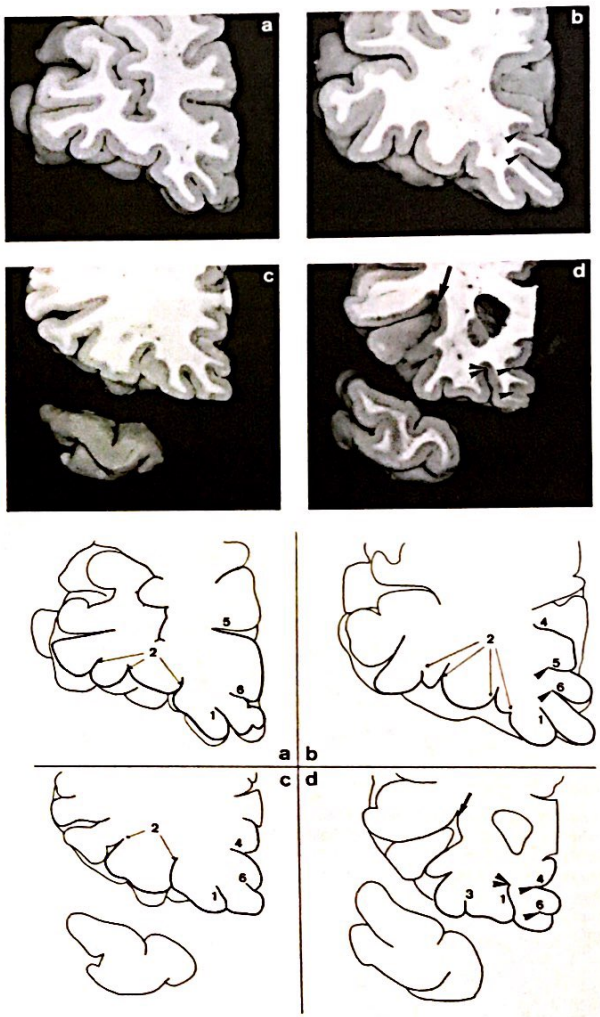
A Inferior surface
B Medial surface

Pattern of the sulci (A, B, Place of sections a–d)

1. Olfactory sulcus
2. Orbital sulcus
3. Side branch of the Sylvian fissure
4. Cingulate sulcus
5. Superior rostral sulcus
6. Inferior rostral sulcus

Note: section **b** displays superiorly-directed superior and inferior rostral sulci (single arrowheads). Section **d** displays the proximity of the Sylvian fissure (single arrow) and the olfactory sulcus (double arrowheads) to the frontal horn of the lateral ventricle.

Figure 17.2



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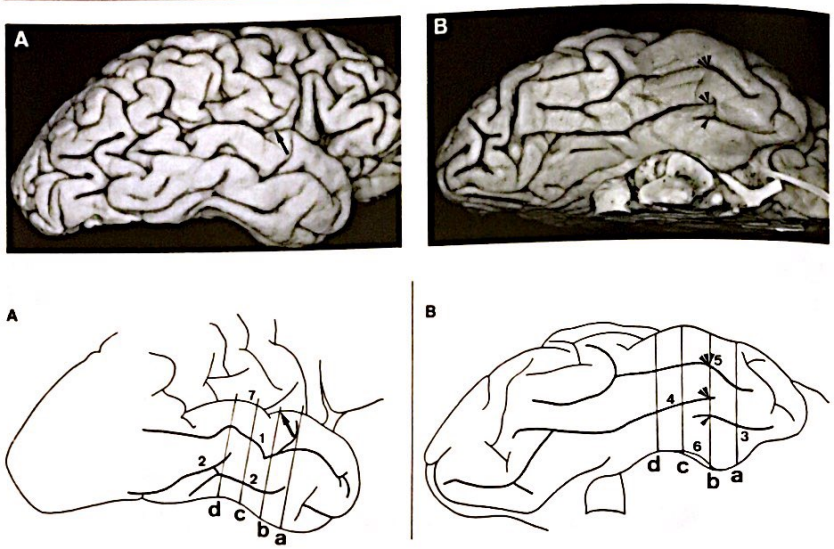


Figure 17.3
Coronal sections: temporal lobe

A Lateral surface
B Inferior surface

Pattern of the sulci (A, B, Place of the sections a–d)
1. Superior temporal sulcus
2. Inferior temporal sulcus
3. Rhinal sulcus
4. Collateral sulcus
5. Occipitotemporal sulcus
6. Anterior hippocampal sulcus
7. Sylvian fissure

Note: section **b** displays the proximity of the rhinal sulcus (single arrowhead), the collateral sulcus (double arrowheads), and the occipitotemporal sulcus (triple arrowheads) to the floor of the temporal horn of the lateral ventricle. The inferior portion of the circular sulcus around the insula (single arrow) is near the roof of the temporal horn.

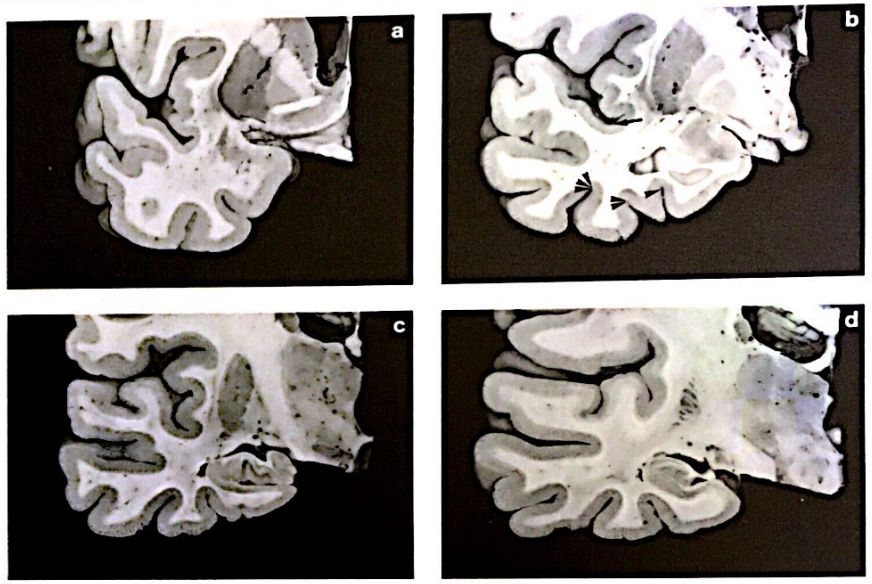
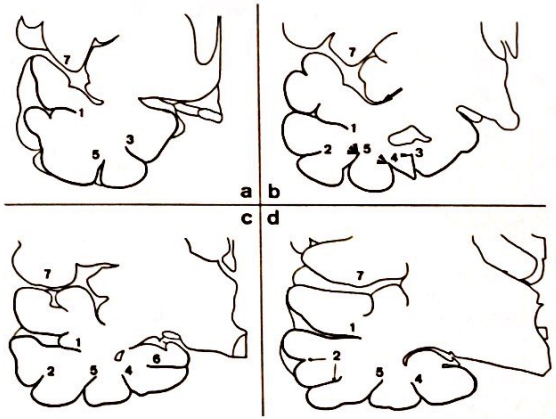


Figure 17.3



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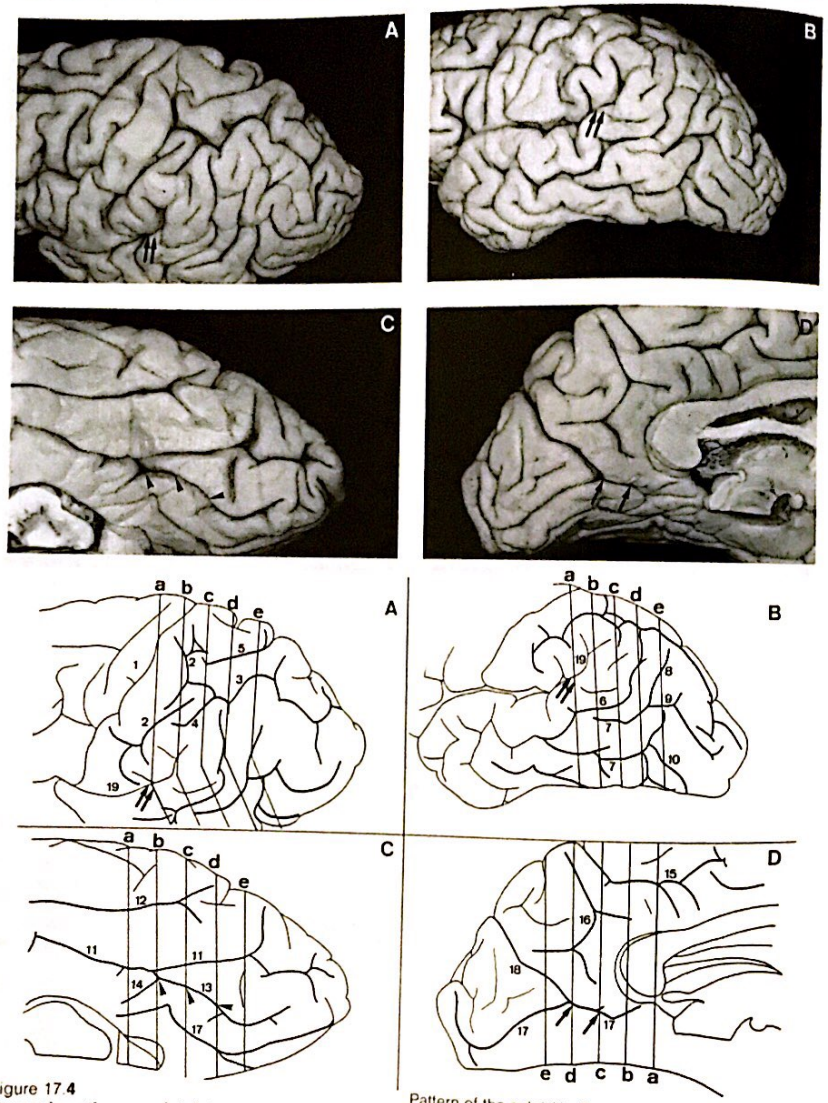
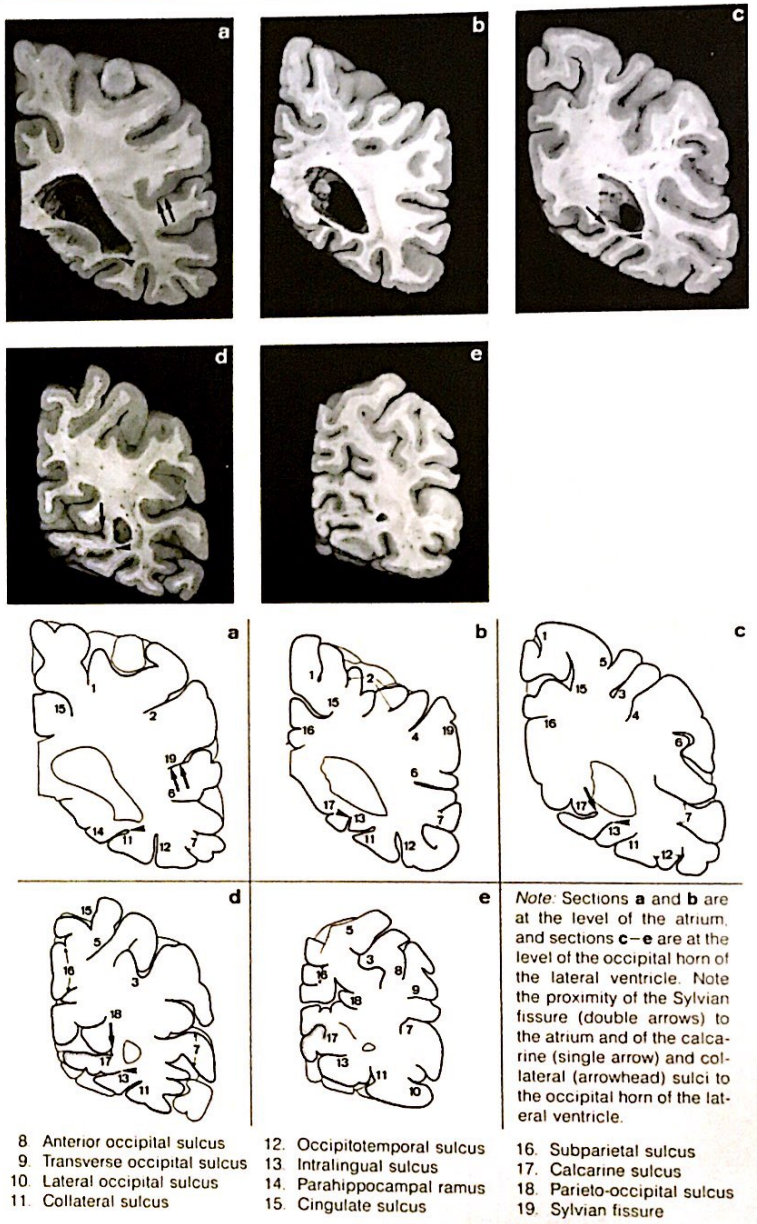


Figure 17.4
Coronal sections: parietal, temporal, and occipital lobes

A Lateral surface – parietal lobe
B Lateral surface – temporal and occipital lobes
C Inferior surface – temporal and occipital lobes
D Medial surface – parietal and occipital lobes

Pattern of the sulci (A–D, Place of sections a–e)
1. Central sulcus
2. Postcentral sulcus
3. Intraparietal sulcus
4. Primary intermediate sulcus
5. Superior parietal sulcus
6. Angular sulcus
7. Double inferior temporal sulcus

Fig. 17.4



Note: Sections **a** and **b** are at the level of the atrium, and sections **c**–**e** are at the level of the occipital horn of the lateral ventricle. Note the proximity of the Sylvian fissure (double arrows) to the atrium and of the calcarine (single arrow) and collateral (arrowhead) sulci to the occipital horn of the lateral ventricle.

8. Anterior occipital sulcus
9. Transverse occipital sulcus
10. Lateral occipital sulcus
11. Collateral sulcus
12. Occipitotemporal sulcus
13. Intralingual sulcus
14. Parahippocampal ramus
15. Cingulate sulcus
16. Subparietal sulcus
17. Calcarine sulcus
18. Parieto-occipital sulcus
19. Sylvian fissure

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Chapter 18
Horizontal Sections

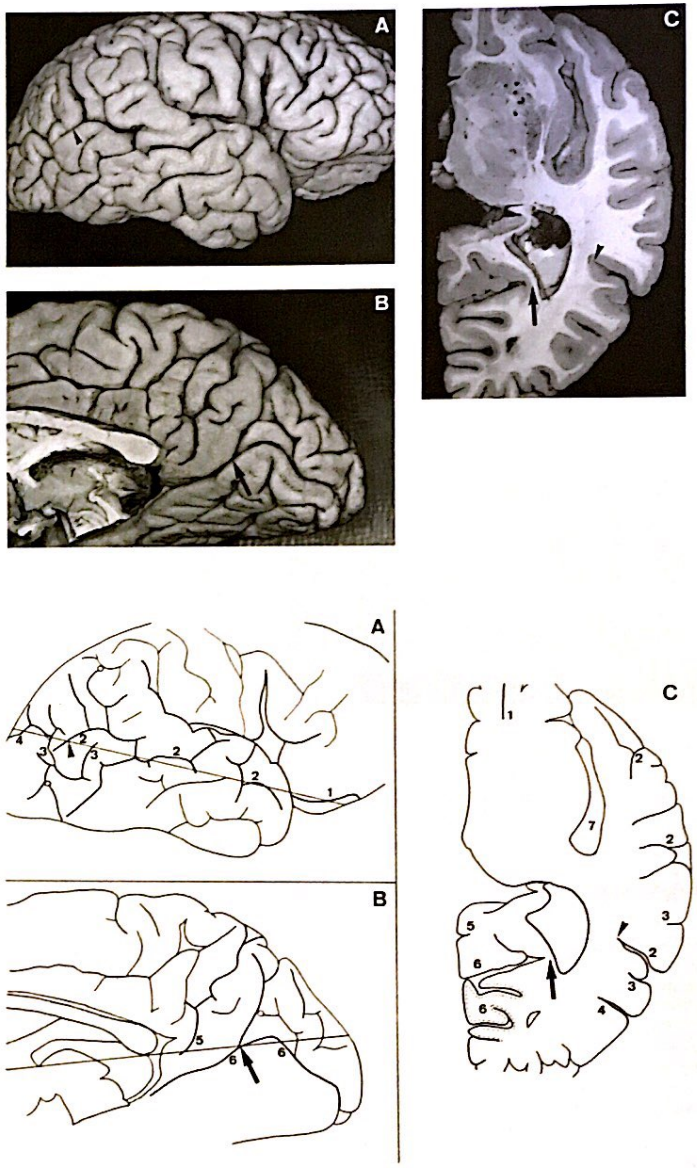
Figure 18.1 ▷
Horizontal sections: level of the superior temporal sulcus

A Lateral surface
B Medial surface
C Horizontal section

Pattern of the sulci (A–C)

1. Olfactory sulcus
2. Superior temporal sulcus
3. Inferior temporal sulcus
4. Lateral occipital sulcus
5. Subparietal sulcus
6. Calcarine sulcus
7. Sylvian fissure

Note: the calcarine sulcus is nearest the medial wall of the occipital horn at the level of its junction with the parieto-occipital sulcus (single arrows). Note the proximity of the posterior end of the superior temporal sulcus to the lateral wall of the atrium (arrowhead).



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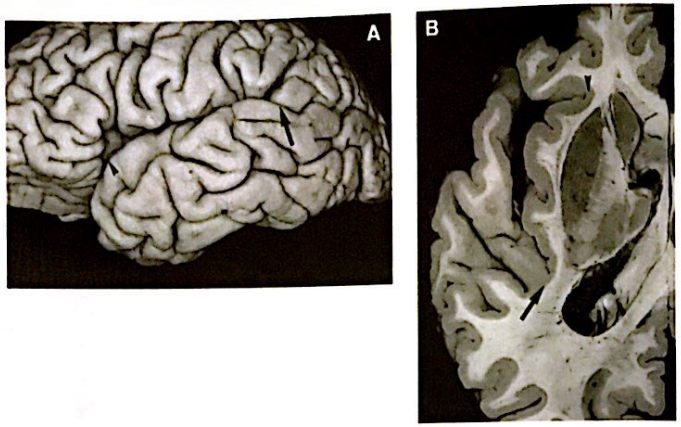

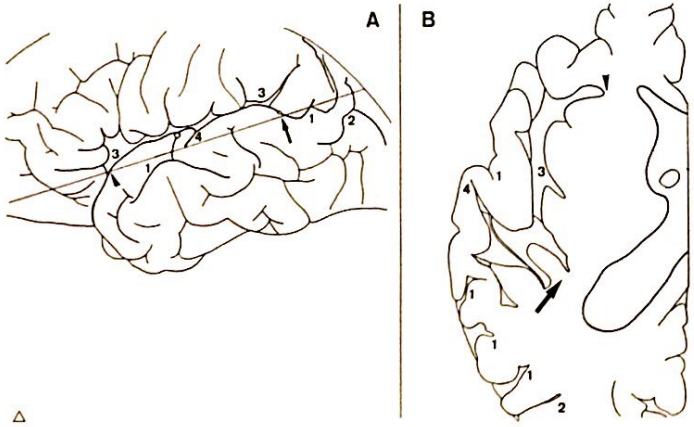

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Figure 18.2
Horizontal sections: level of the Sylvian fissure

A Lateral surface
B Horizontal section

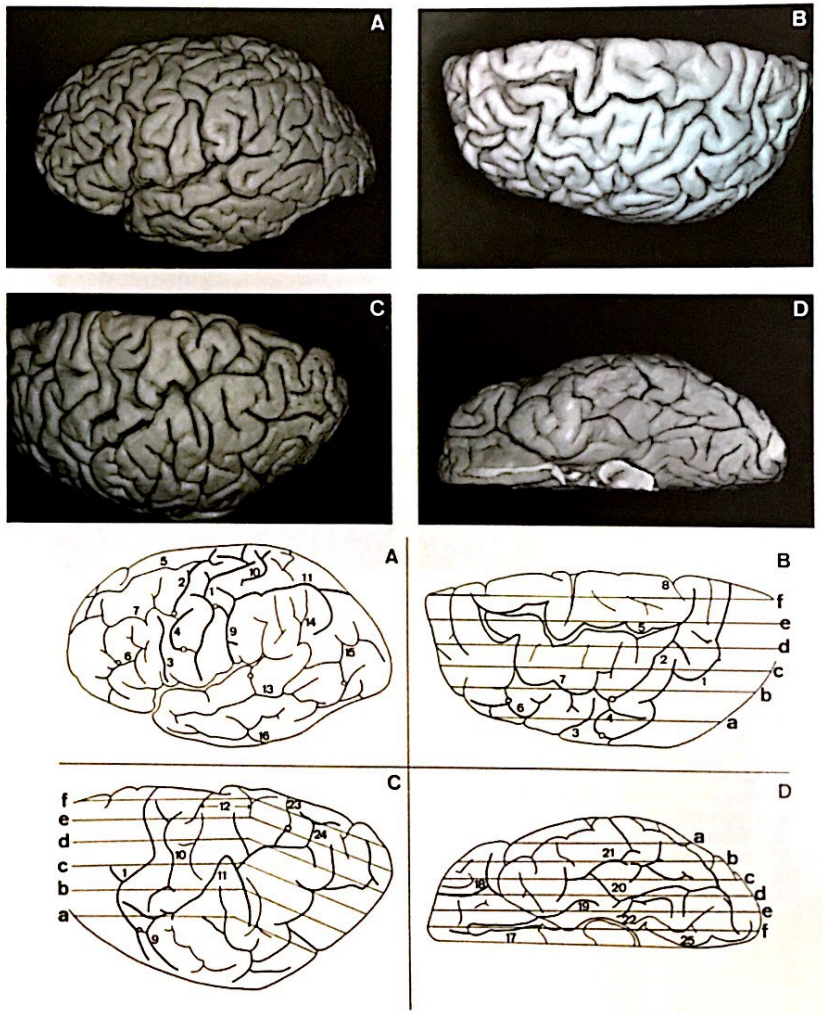
Pattern of the sulci (A, B)
1. Superior temporal sulcus
2. Inferior temporal sulcus
3. Sylvian fissure
4. Transverse temporal sulcus

Note: the anterior end of the circular sulcus around the insula is near the anterolateral angle of the frontal horn of the lateral ventricle (arrowheads). The posterior end of the circular sulcus is near the lateral wall of the atrium, as is the posterior end of the transverse temporal gyrus (arrows)

Figure 19.1 ▷
Sagittal sections: entire hemisphere

A Lateral surface
B Lateral surface – frontal lobe
C Lateral surface – parietal and occipital lobes
D Inferior surface – frontal, temporal and occipital lobes

Chapter 19
Sagittal Sections



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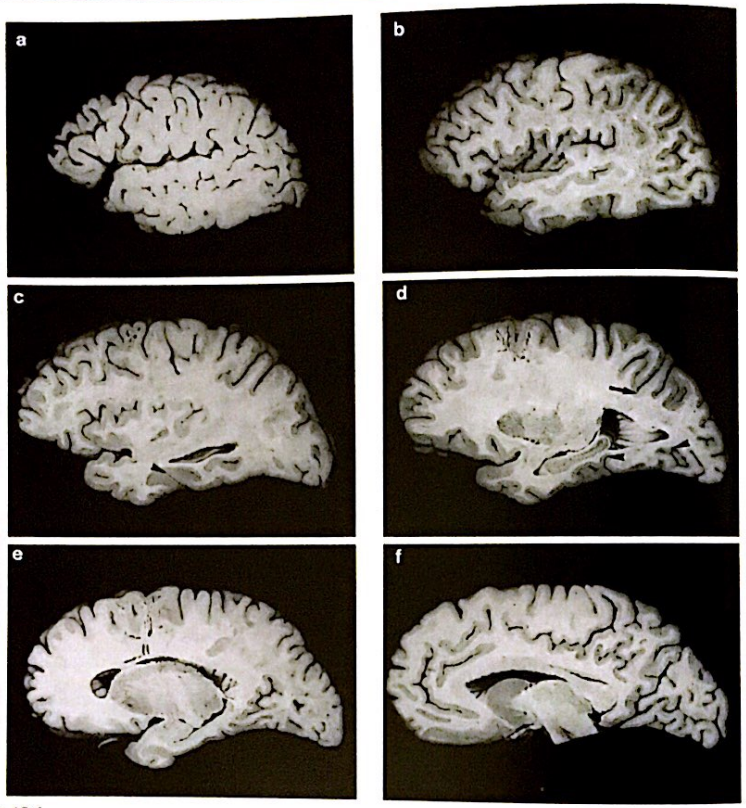
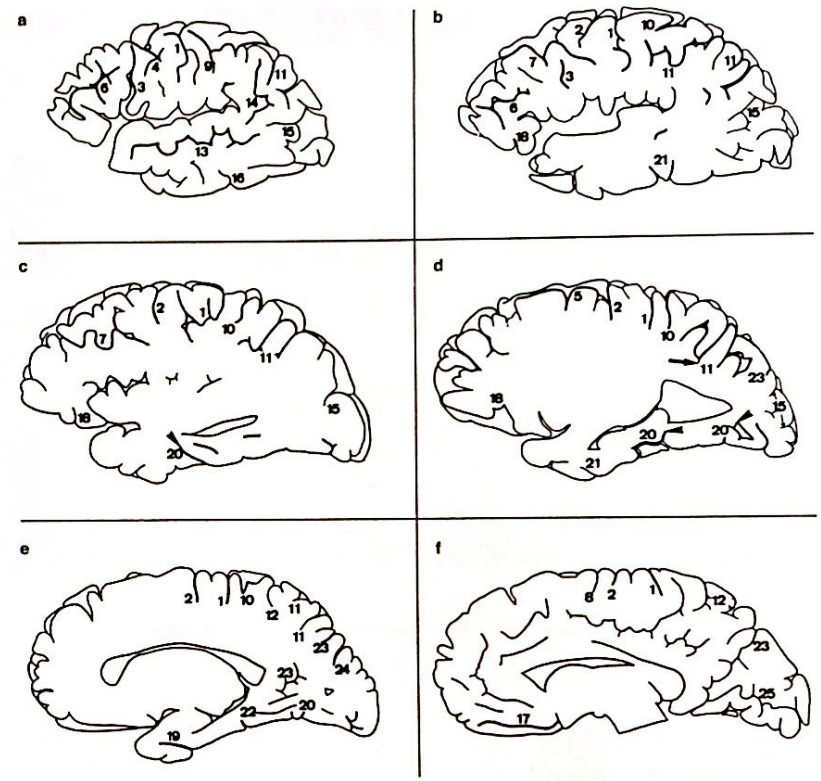


Figure 19.1

Pattern of the sulci (A–D, a–f)

1. Central sulcus
2. Superior precentral sulcus
3. Inferior precentral sulcus
4. Intermediate precentral sulcus
5. Superior frontal sulcus
6. Inferior frontal sulcus
7. Intermediate frontal sulcus
8. Medial precentral sulcus
9. Postcentral sulcus – inferior segment
10. Postcentral sulcus – superior segment
11. Intraparietal sulcus
12. Superior parietal sulcus
13. Superior temporal sulcus
14. Superior temporal sulcus – parietal extension
15. Superior temporal sulcus – occipital extension
16. Inferior temporal sulcus
17. Olfactory sulcus
18. Orbital sulcus
19. Rhinal sulcus
20. Collateral sulcus
21. Occipitotemporal sulcus
22. Parahippocampolingual sulcus
23. Parieto-occipital sulcus
24. Transverse occipital sulcus
25. Calcarine sulcus

Note: sections **c** and **d** display the proximity of the collateral sulcus to the floor of the lateral ventricle (arrowheads). Note that the intraparietal sulcus is near the roof of the atrium and the occipital horn (arrow).



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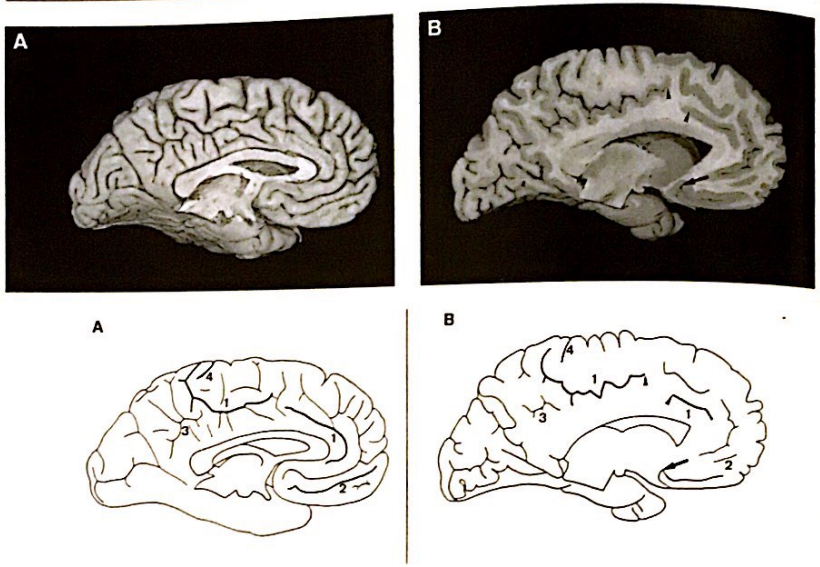

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Figure 19.2
Sagittal sections: entire hemisphere

A Medial surface
B Sagittal section

Pattern of the sulci (A, B)
1. Cingulate sulcus
2. Superior rostral sulcus
3. Subparietal sulcus
4. Central sulcus

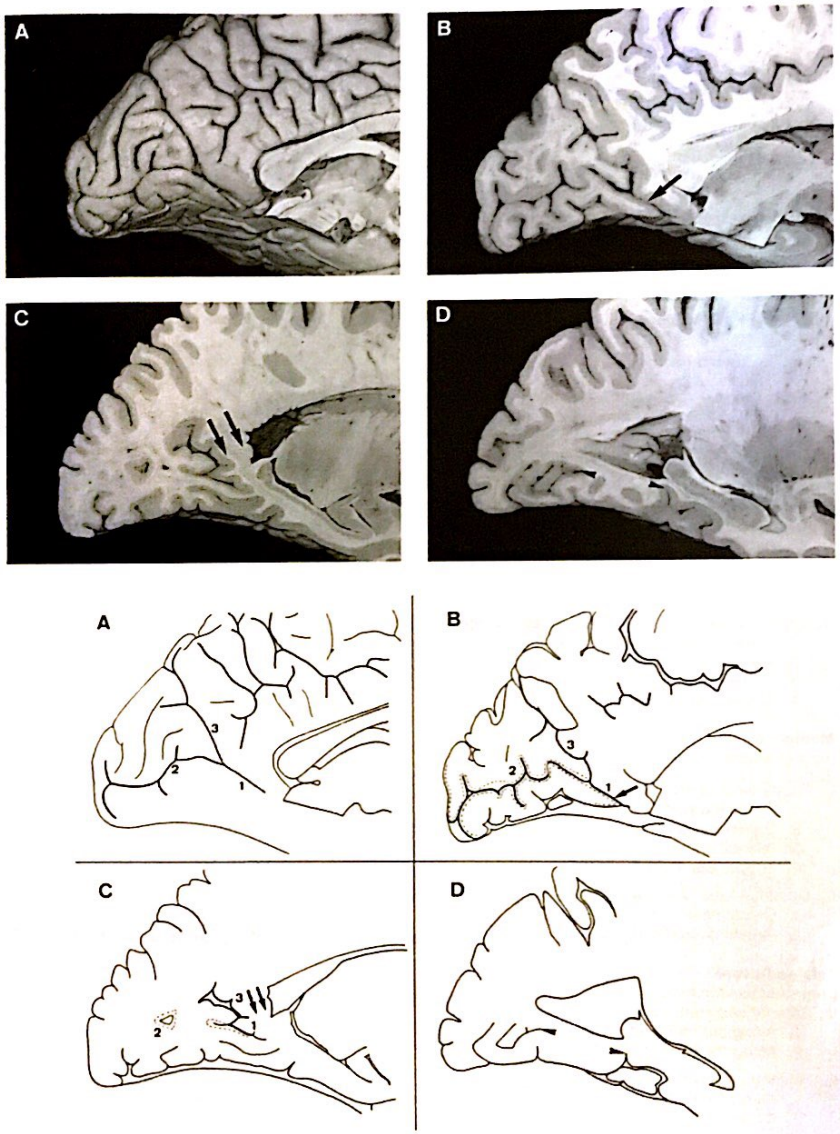
Note: the posterior end of the superior rostral sulcus lies below the frontal horn of the lateral ventricle (arrow). The interruption of the cingulate sulcus is more obvious on the cut section (arrowhead).

Figure 19.3 ▷
Sagittal sections: occipital lobe

A Lateral surface
B 8 mm lateral section
C 16 mm lateral section
D 24 mm lateral section

Pattern of the sulci (A–D)
1. Calcarine sulcus – anterior segment
2. Calcarine sulcus – posterior segment
3. Parieto-occipital sulcus

Note: section B displays the "Stripe of Gennari" (dotted lines). Notice that the "Stripe of Gennari" only exists on the inferior side of the anterior segment of the calcarine sulcus (arrow). Section C displays the access to the atrium from the medial surface (double arrow). Section D displays the relationship of the collateral sulcus to the floor of the atrium and occipital horn of the lateral ventricle (arrowhead).



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Chapter 20
Depth of the Sulci

Lateral surface
(measurements in mm)

	R	L
I. Frontal lobe: average (range)	16.6 (6–30)	16.0 (7–22)
1. Central sulcus	14.1 (8–22)	14.1 (7–21)
2. Superior precentral sulcus	17.8 (6–30)	16.0 (7–22)
3. Inferior precentral sulcus	14.5 (7–21)	14.9 (7–23)
4. Superior frontal sulcus	13.8 (5–20)	14.6 (5–22)
5. Inferior frontal sulcus	16.3 (6–20)	13.4 (4–33)
6. Intermediate frontal sulcus		
II. Parietal and occipital lobes: average (range)	14.7 (5–25)	15.7 (8–34)
1. Postcentral sulcus	19.4 (4–33)	19.5 (6–41)
2. Intraparietal sulcus	14.8 (4–26)	12.1 (2–26)
3. Lateral occipital sulcus		
III. Temporal lobe: average (range)	18.0 (5–25)	17.4 (3–26)
1. Superior temporal sulcus	10.2 (2–22)	9.9 (5–16)
2. Inferior temporal sulcus		

Inferior surface
(measurements in mm)

	R	L
I. Frontal lobe: average (range)	6.5 (2–17)	6.0 (2–10)
1. Olfactory sulcus	7.9 (3–11)	7.9 (3–10)
2. Orbital sulci		
II. Temporal and occipital lobes: average (range)	10.2 (4–16)	10.3 (7–15)
1. Anterior hippocampal sulcus	6.9 (3–13)	8.2 (4–12)
2. Rhinal sulcus	9.4 (4–15)	9.8 (2–17)
3. Collateral sulcus	9.4 (4–16)	10.1 (5–16)
4. Occipitotemporal sulcus		

Medial surface
(measurements in mm)

	R	L
I. Frontal and parietal lobes: average (range)	10.4 (4–21)	10.7 (2–17)
1. Cingulate sulcus	7.1 (2–11)	7.9 (2–17)
2. Superior rostral sulcus	4.8 (2–10)	4.5 (1– 8)
3. Inferior rostral sulcus	6.8 (2–18)	7.6 (3–13)
4. Subparietal sulcus		
II. Occipital lobe: average (range)	16.5 (2–33)	15.2 (2–33)
1. Calcarine sulcus	24.2 (17–40)	22.0 (12–33)
2. Parieto-occipital sulcus		

Sylvian fissure
(measurements in mm)

	R	L
I. Anterior segment: average (range)	29.6 (24–33)	25.4 (21–37)
1. Along the roof of the fissure	25.8 (19–29)	22.4 (12–33)
2. Along the floor of the fissure		
II. Posterior segment: average (range)	35.4 (31–40)	32.0 (29–35)
1. Along the roof of the fissure	36.6 (32–41)	31.8 (29–37)
2. Along the floor of the fissure		
III. Average of the entire fissure: average (range)	29.2 (11–40)	28.7 (17–37)
1. Along the roof of the fissure	30.4 (19–41)	28.3 (12–39)
2. Along the floor of the fissure		

Chapter 21
Distance Between the Sulci and the Ventricles

Note: F = frontal horn, B = body, A = atrium, T = temporal horn, and O = occipital horn.

Lateral Surface
(measurements in mm)

	R	L
I. Frontal lobe: average (range)		
1. Central sulcus	B 21.6 (17–28)	19.1 (15–24)
	A 20.2 (18–24)	25.2 (16–32)
2. Superior precentral sulcus	B 18.7 (11–23)	24.2 (20–28)
3. Inferior precentral sulcus	F 16.5 (12–24)	25.0 (20–28)
	B 19.0 (18–22)	20.0 (10–32)
4. Superior frontal sulcus	F 18.5 (13–27)	19.5 (11–27)
	B 16.3 (14–18)	17.8 (14–20)
5. Inferior frontal sulcus	F 18.7 (15–25)	19.3 (15–25)
6. Intermediate frontal sulcus	F 18.4 (17–21)	18.2 (15–25)
II. Parietal and occipital lobes: average (range)		
1. Postcentral sulcus	B 26.7 (23–33)	21.7 (17–25)
	A 16.8 (10–22)	22.4 (16–36)
	O 19.8 (12–30)	18.0 (14–24)
2. Intraparietal sulcus	O 18.4 (12–28)	19.2 (10–29)
III. Temporal lobe: average (range)		
1. Superior temporal sulcus	T 10.2 (7–18)	11.5 (8–19)
	A 9.8 (7–13)	11.3 (8–21)
	O 11.3 (10–14)	13.8 (9–18)
2. Inferior temporal sulcus	T 16.1 (12–20)	14.8 (11–18)
	A 16.8 (12–22)	12.4 (5–17)
	O 12.2 (7–19)	11.4 (7–18)

Inferior surface
(measurements in mm)

	R	L
I. Frontal lobe: average (range)		
1. Olfactory sulcus	F 10.0 (6–16)	10.3 (8–16)
2. Orbital sulci	F 9.3 (9–11)	13.1 (8–18)
II. Temporal and occipital lobes: average (rage)		
1. Anterior hippocampal sulcus	T 4.3 (3– 6)	3.9 (2– 7)
2. Rhinal sulcus	T 3.7 (2– 7)	4.4 (3–11)
3. Collateral sulcus	T 4.1 (3– 5)	5.0 (3–12)
	A 3.0 (2– 4)	3.0 (2– 4)
	O 3.3 (2– 6)	4.5 (2– 9)
4. Occipitotemporal sulcus	T 5.8 (3– 9)	5.0 (2–11)
	A 7.8 (5–11)	8.0 (5–11)
	O 8.9 (6–12)	6.9 (6– 9)

Medial surface
(measurements in mm)

	R	L
I. Frontal and parietal lobes: average (range)		
1. Callosal sulcus	F 4.8 (3– 6)	5.2 (3–10)
	B 4.0 (2– 5)	3.8 (2– 5)
	A 6.9 (5– 8)	5.2 (3– 7)

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	R	L
2. Cingulate sulcus	F 10.8 (7–17)	10.1 (5–13)
	B 10.3 (6–20)	8.6 (5–13)
	A 11.4 (9–15)	9.2 (7–12)
	O 20.3 (12–27)	14.0 (9–19)
3. Superior rostral sulcus	F 9.2 (6–12)	10.0 (8–12)
4. Subparietal sulcus	O 17.0 (11–22)	17.7 (7–22)
II. Occipital lobe: average (range)		
1. Calcarine sulcus	A 9.2 (4–16)	9.0 (8–11)
	O 4.3 (2–13)	3.4 (2– 7)

Sylvian fissure
(measurements in mm)

Sylvian fissure to lateral ventricle distance: average (range)	R	L
1. From the roof of the fissure	F 14.4 (9–20)	13.4 (8–20)
	B 17.1 (11–23)	16.0 (10–23)
2. From the floor of the fissure	T 9.2 (6–15)	8.9 (7–14)

8

Inner Structures of the Sulci

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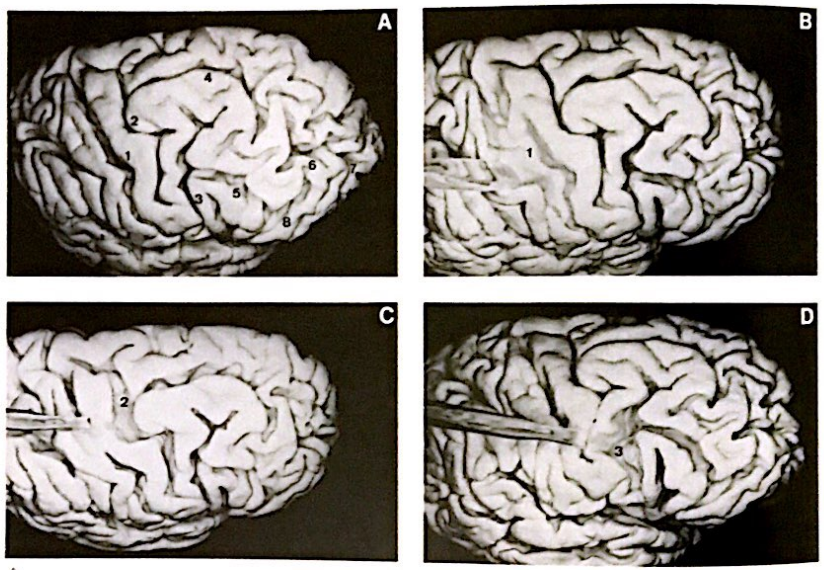
Chapter 22
Lateral Surface

In this and the following three chapters, the inner structures of the sulci are demonstrated on a rubberized model for opening the sulci.



△

Figure 22.1
Lateral surface: frontal lobe

A Lateral surface of the frontal lobe
B Central sulcus
C Superior precentral sulcus
D Inferior precentral sulcus

Sulci
1. Central sulcus
2. Superior precentral sulcus
3. Inferior precentral sulcus
4. Superior frontal sulcus
5. Inferior frontal sulcus
6. Intermediate frontal sulcus
7. Frontomarginal sulcus
8. Fronto-orbital sulcus

Figure 22.3 ▷
Lateral surface: parietal and occipital lobes

A Lateral surface of the parietal and occipital lobes
B Postcentral sulcus
C Intraparietal sulcus
D Transverse occipital and lateral occipital sulci

Sulci
1. Central sulcus
2. Postcentral sulcus
3. Intraparietal sulcus
4. Transverse occipital sulcus
5. Lateral occipital sulcus
6. Superior temporal sulcus
7. Sulcus of the preoccipital incisura
8. Sylvian fissure

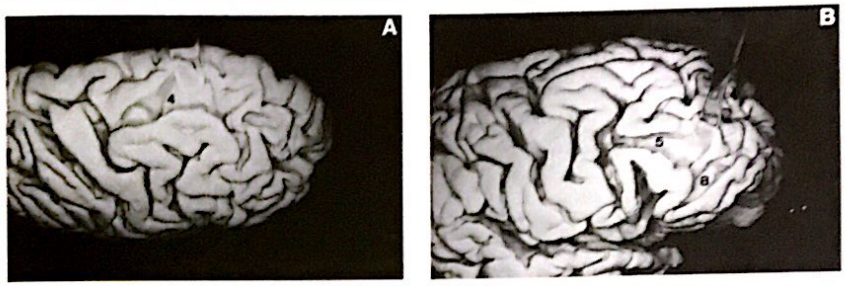
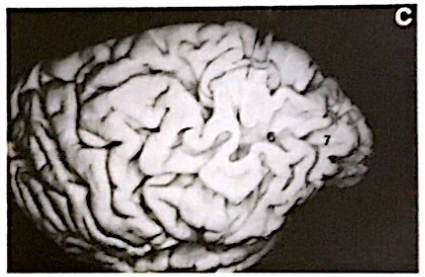
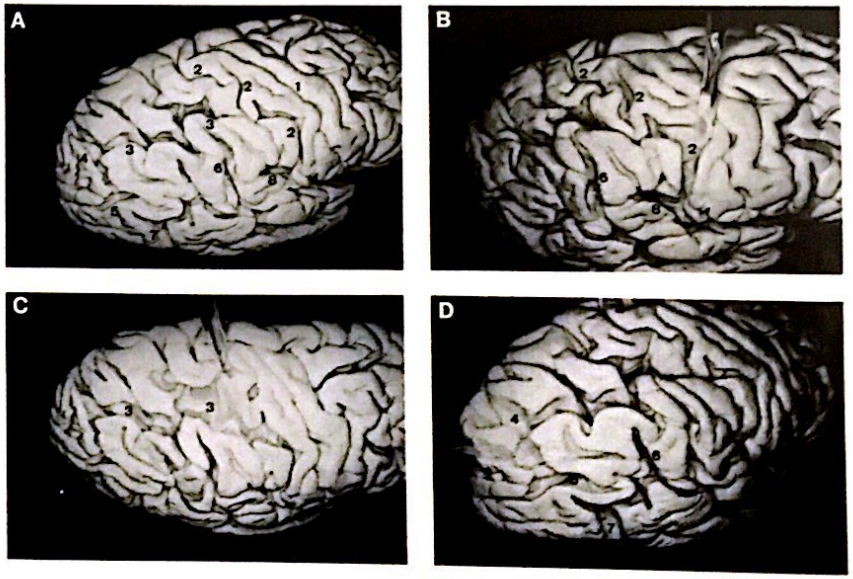


Figure 22.2
Lateral surface: frontal lobe

A Superior frontal sulcus
B Inferior frontal and fronto-orbital sulci
C Intermediate frontal and frontomarginal sulci

Sulci
4. Superior frontal sulcus
5. Inferior frontal sulcus
6. Intermediate frontal sulcus
7. Frontomarginal sulcus
8. Fronto-orbital sulcus





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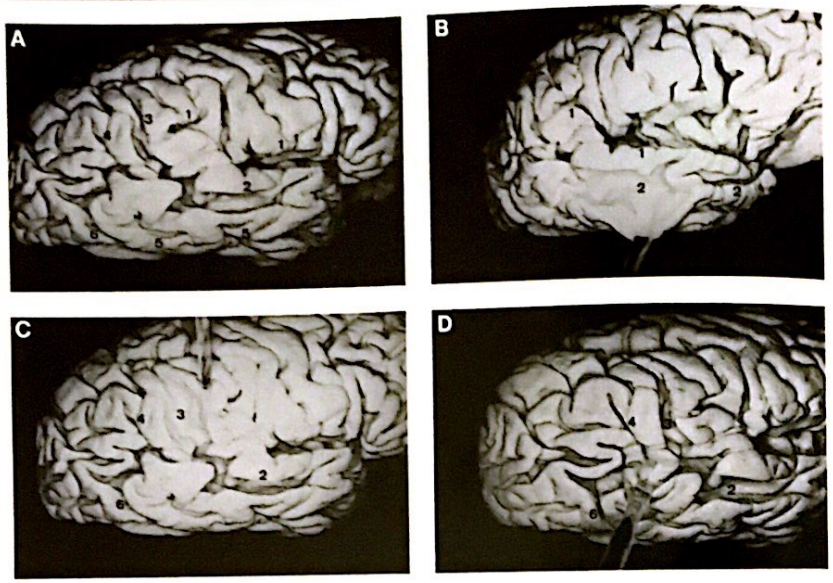

Figure 22.4
Lateral surface: temporal lobe

A Lateral surface of the temporal lobe
B Superior temporal sulcus
C Angular sulcus
D Superior temporal sulcus – posterior extension

Sulci
1. Sylvian fissure
2. Superior temporal sulcus
3. Angular sulcus
4. Anterior occipital sulcus
5. Inferior temporal sulcus
6. Sulcus of the preoccipital incisura

Chapter 23
Inferior Surface

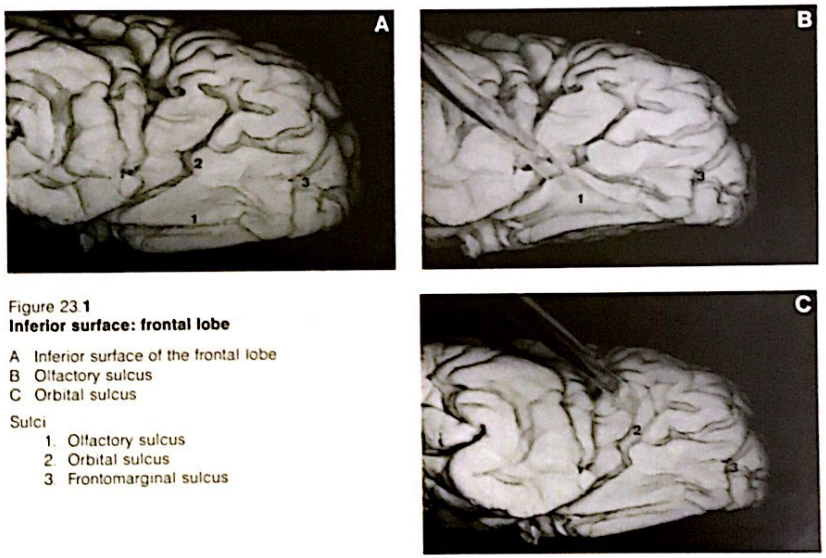

Figure 23.1
Inferior surface: frontal lobe

A Inferior surface of the frontal lobe
B Olfactory sulcus
C Orbital sulcus

Sulci
1. Olfactory sulcus
2. Orbital sulcus
3. Frontomarginal sulcus

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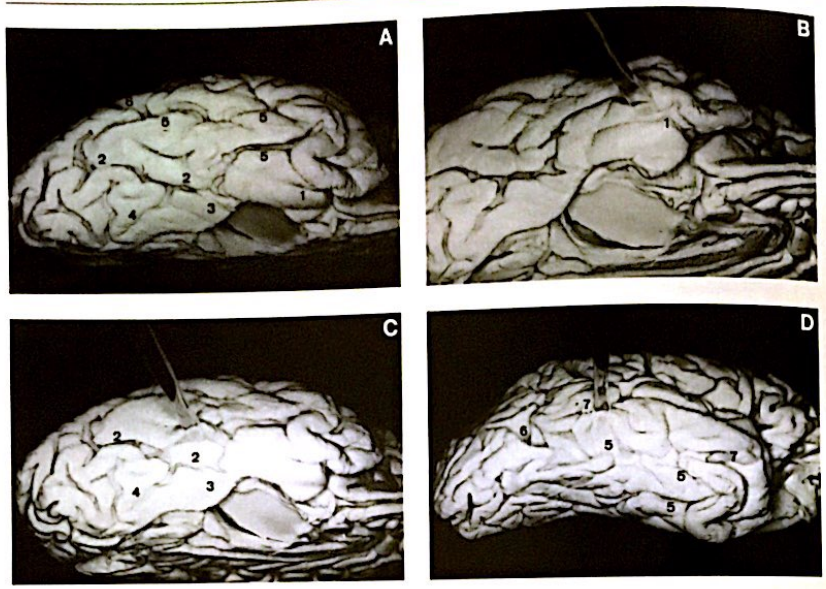

Figure 23.2
Inferior surface: temporal and occipital lobes

A Inferior surface of the temporal and occipital lobes
B Rhinal sulcus
C Collateral sulcus
D Occipitotemporal sulcus

Sulci
1. Rhinal sulcus
2. Collateral sulcus
3. Parahippocampolingual sulcus
4. Intralingual sulcus
5. Occipitotemporal sulcus
6. Sulcus of the preoccipital incisura
7. Inferior temporal sulcus

Chapter 24
Medial Surface

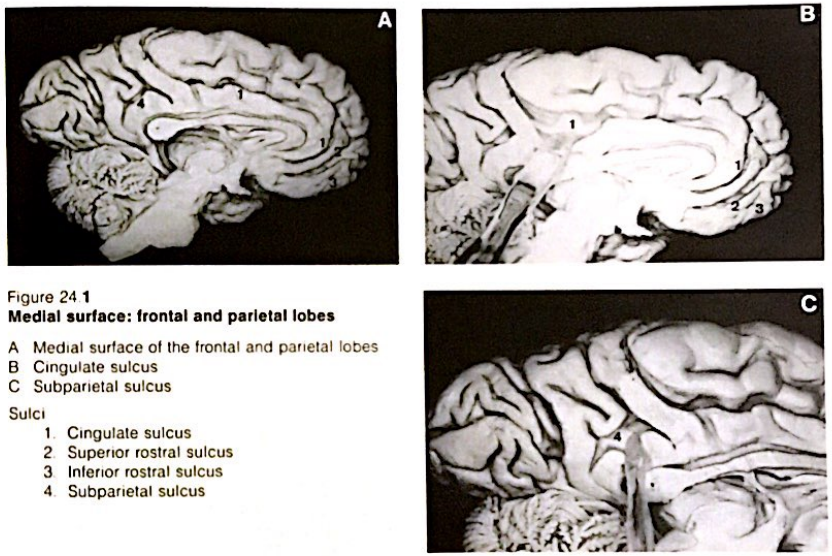

Figure 24.1
Medial surface: frontal and parietal lobes

A Medial surface of the frontal and parietal lobes
B Cingulate sulcus
C Subparietal sulcus

Sulci
1. Cingulate sulcus
2. Superior rostral sulcus
3. Inferior rostral sulcus
4. Subparietal sulcus

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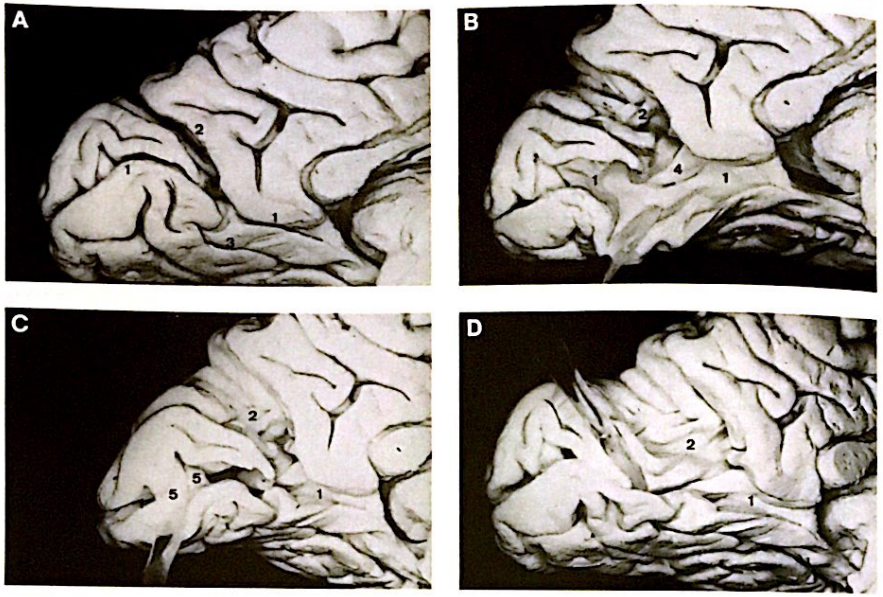

Figure 24.2
Medial surface: occipital lobe

A Medial surface of the occipital lobe
B Calcarine sulcus – anterior extension
C Calcarine sulcus – posterior extension
D Parieto-occipital sulcus

Sulci
1. Calcarine sulcus
2. Parieto-occipital sulcus
3. Collateral sulcus
4. Apex of the cuneus
5. Pillar of the calcarine sulcus

Chapter 25
Sylvian Fissure

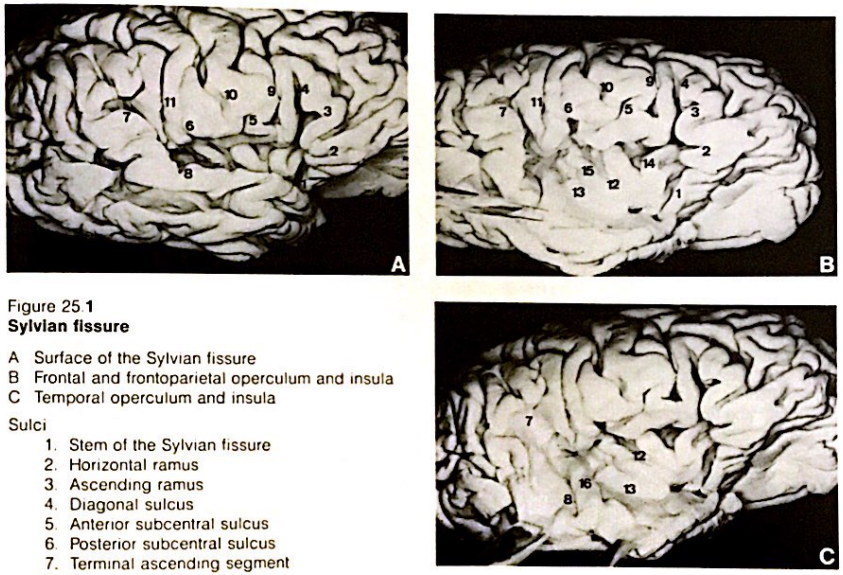

Figure 25.1
Sylvian fissure

A Surface of the Sylvian fissure
B Frontal and frontoparietal operculum and insula
C Temporal operculum and insula

Sulci
1. Stem of the Sylvian fissure
2. Horizontal ramus
3. Ascending ramus
4. Diagonal sulcus
5. Anterior subcentral sulcus
6. Posterior subcentral sulcus
7. Terminal ascending segment
8. Transverse temporal sulcus
9. Precentral sulcus
10. Central sulcus
11. Postcentral sulcus
12. Central sulcus of the insula
13. Circular sulcus
14. Short gyrus of the insula
15. Long gyrus of the insula
16. Transverse temporal gyrus

Scanned with CamScanner

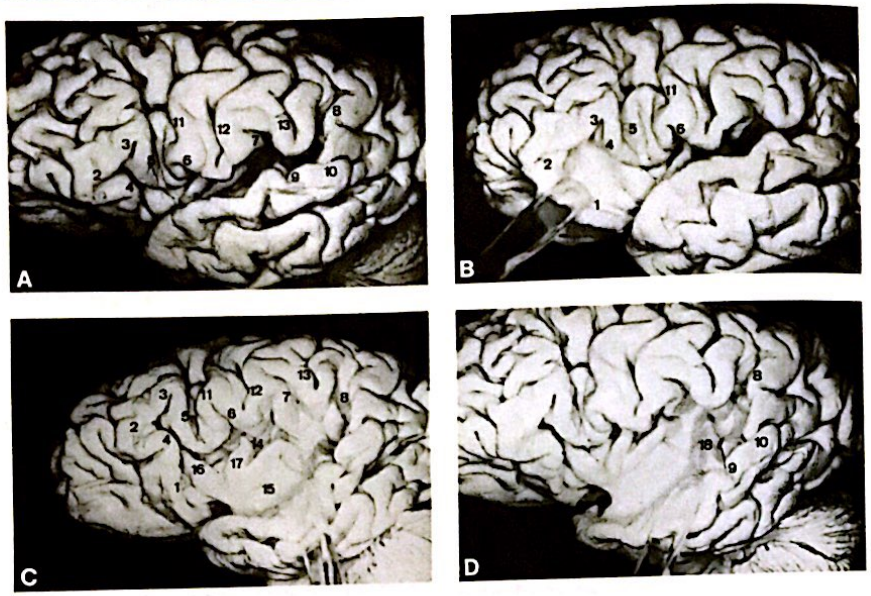

Figure 25.2
Sylvian fissure

A Surface of the Sylvian fissure
B Frontal operculum – pars orbitalis and pars triangularis
C Frontal and frontoparietal operculum and insula
D Temporal operculum and insula

Sulci
1. Stem of the Sylvian fissure
2. Horizontal ramus
3. Ascending ramus
4. Common trunk
5. Diagonal sulcus
6. Anterior subcentral sulcus
7. Posterior subcentral sulcus
8. Terminal ascending segment
9. Transverse temporal sulcus
10. Terminal descending segment
11. Precentral sulcus
12. Central sulcus
13. Postcentral sulcus
14. Central sulcus of the insula
15. Circular sulcus
16. Short gyrus of the insula
17. Long gyrus of the insula
18. Transverse temporal gyrus

9

Arterial and Sulcal Anatomy

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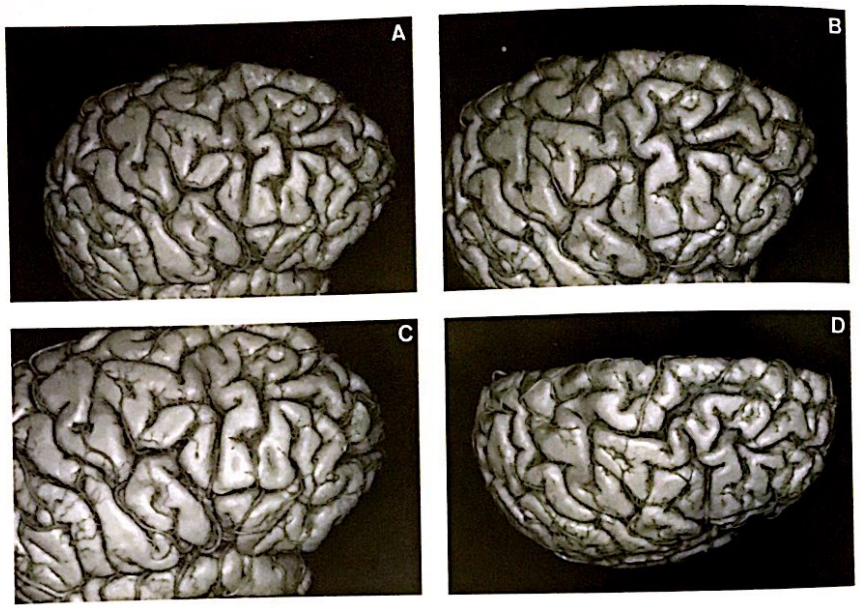
Chapter 26
Lateral Surface



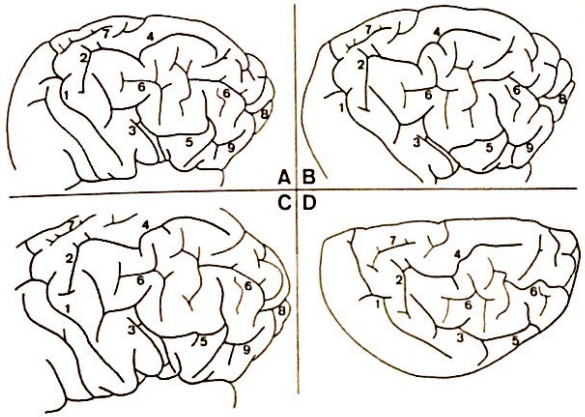


Figure 26.1
Lateral surface: frontal lobe

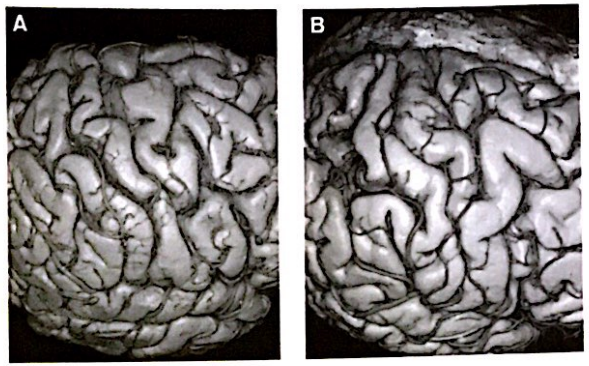
I. Arteries
Anterior cerebral artery
Middle cerebral artery

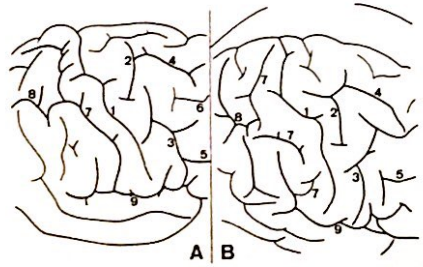
II. Sulci
1. Central sulcus
2. Superior precentral sulcus
3. Inferior precentral sulcus
4. Superior frontal sulcus
5. Inferior frontal sulcus
6. Intermediate frontal sulcus
7. Marginal precentral sulcus
8. Frontomarginal sulcus
9. Fronto-orbital sulcus

Figure 26.2
Lateral surface: central sulcus

I. Arteries
Anterior cerebral artery
Middle cerebral artery

II. Sulci
1. Central sulcus
2. Superior precentral sulcus
3. Inferior precentral sulcus
4. Superior frontal sulcus
5. Inferior frontal sulcus
6. Intermediate frontal sulcus
7. Postcentral sulcus
8. Intraparietal sulcus
9. Sylvian fissure





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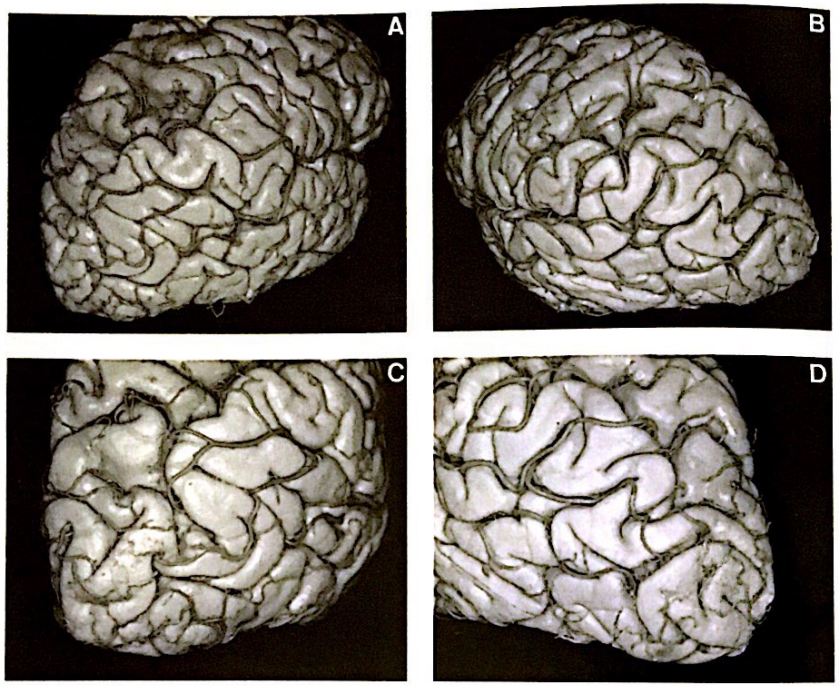


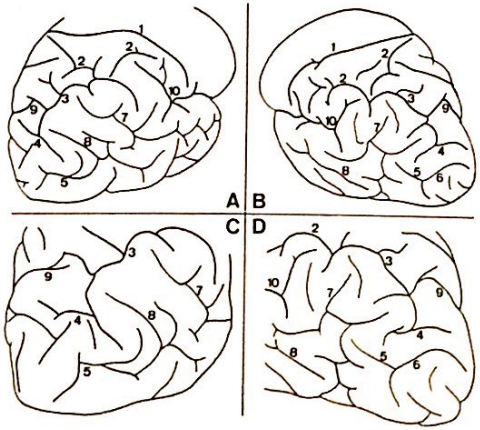


Figure 26.3
Lateral surface: parietal and occipital lobes

I. Arteries (A=C, B=D)
Middle cerebral artery
Posterior cerebral artery

II. Sulci (A=C, B=D)
1. Central sulcus
2. Postcentral sulcus
3. Intraparietal sulcus
4. Transverse occipital sulcus
5. Lateral occipital sulcus
6. Lunate sulcus
7. Superior temporal sulcus
8. Inferior temporal sulcus
9. Parieto-occipital sulcus
10. Sylvian fissure

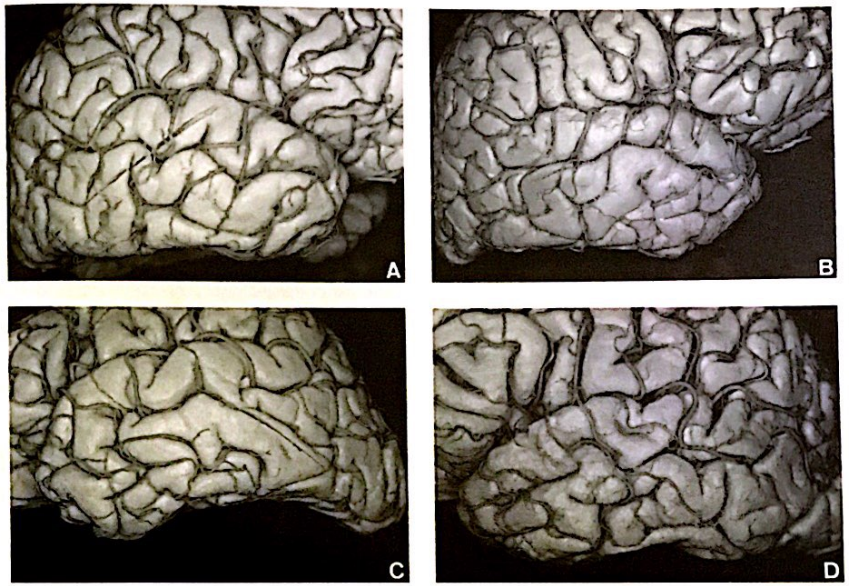
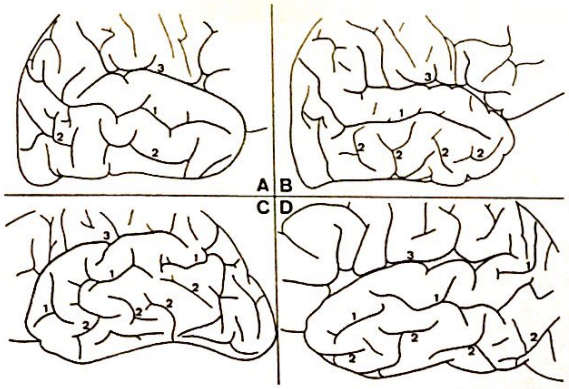


Figure 26.4
Lateral surface: temporal lobe

I. Arteries
Middle cerebral artery

II. Sulci
1. Superior temporal sulcus
2. Inferior temporal sulcus
3. Sylvian fissure



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Chapter 27
Inferior Surface

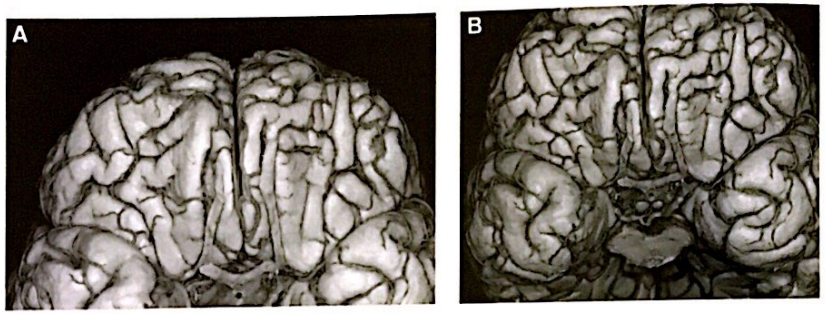
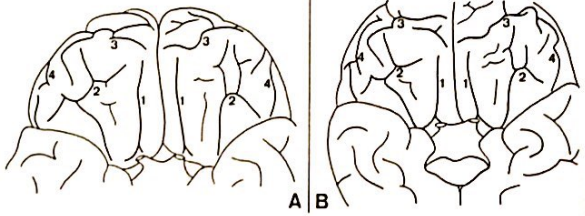


Figure 27.1
Inferior surface: frontal lobe

I. Arteries
Anterior cerebral artery
Middle cerebral artery

II. Sulci
1. Olfactory sulcus
2. Orbital sulcus
3. Frontomarginal sulcus
4. Fronto-orbital sulcus



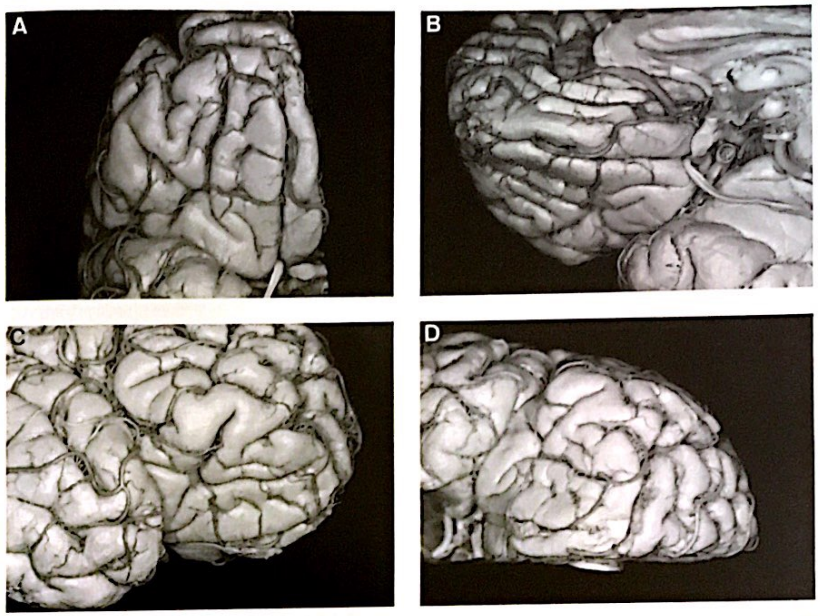
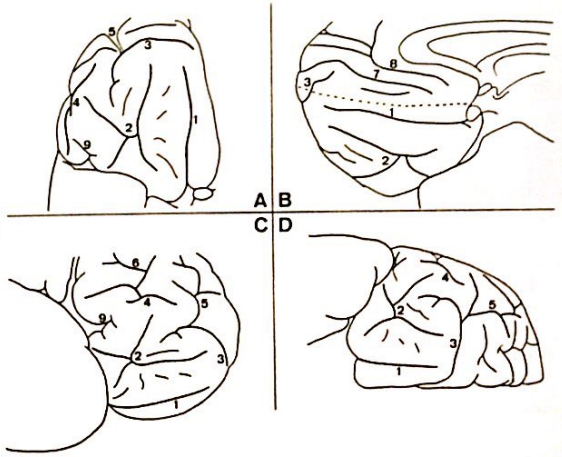


Figure 27.2
Inferior surface: frontal lobe

I. Arteries
Anterior cerebral artery
Middle cerebral artery

II. Sulci
1. Olfactory sulcus
2. Orbital sulcus
3. Frontomarginal sulcus
4. Fronto-orbital sulcus
5. Intermediate frontal sulcus
6. Inferior frontal sulcus
7. Superior rostral sulcus
8. Cingulate sulcus
9. Horizontal ramus of the Sylvian fissure



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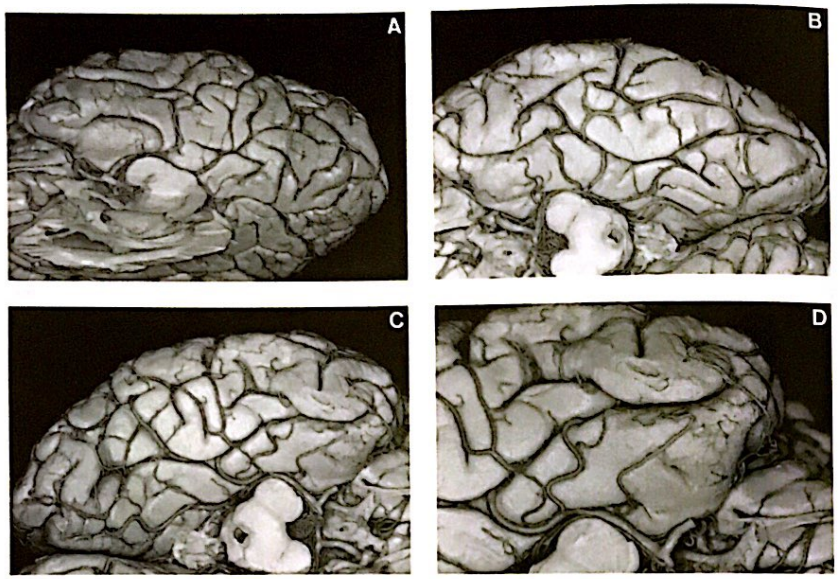


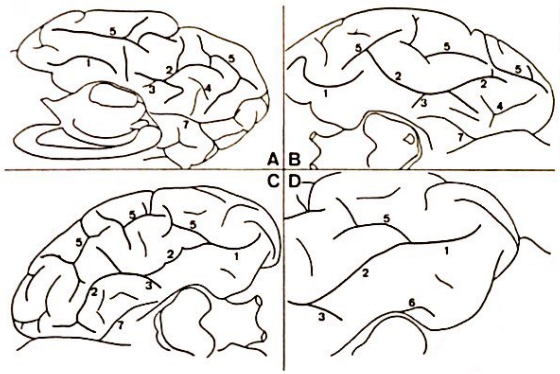


Figure 27.3
Inferior surface: temporal and occipital lobes

I. Arteries
Posterior cerebral artery
Middle cerebral artery

II. Sulci
1. Rhinal sulcus
2. Collateral sulcus
3. Parahippocampolingual sulcus
4. Intralingual sulcus
5. Inferior temporal sulcus
6. Anterior hippocampal sulcus
7. Calcarine sulcus

Chapter 28
Medial Surface

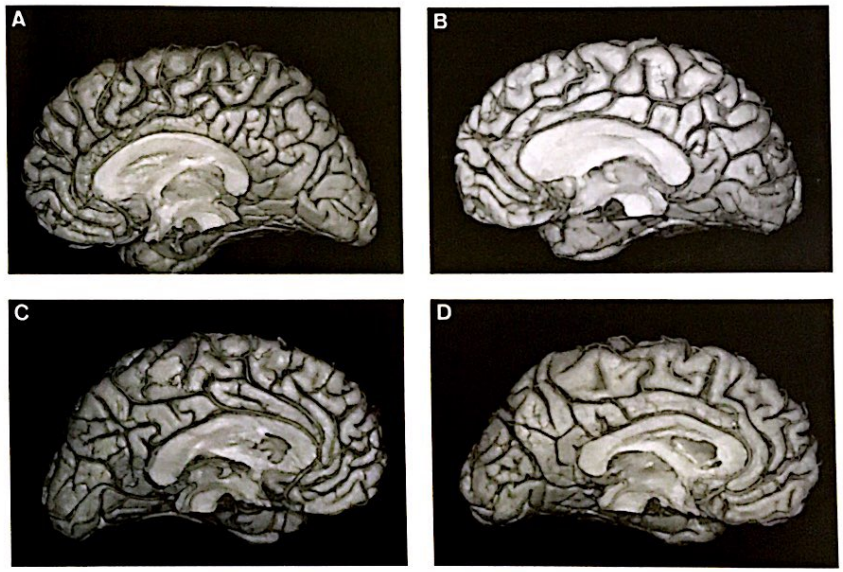
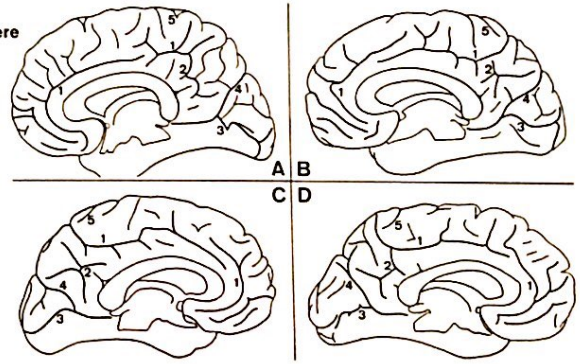


Figure 28.1
Medial surface: entire hemisphere

I. Arteries
Anterior cerebral artery
Posterior cerebral artery

II. Sulci
1. Cingulate sulcus
2. Subparietal sulcus
3. Calcarine sulcus
4. Parieto-occipital sulcus
5. Central sulcus



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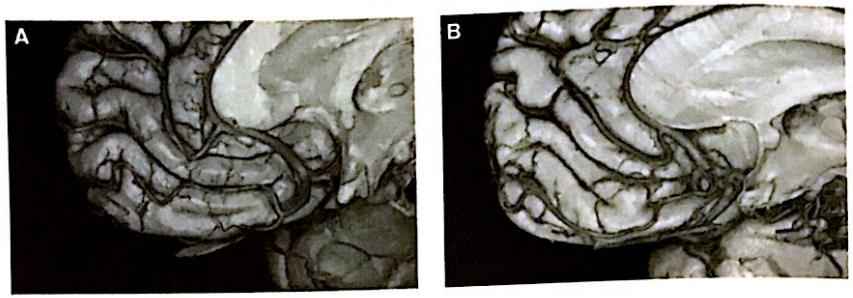
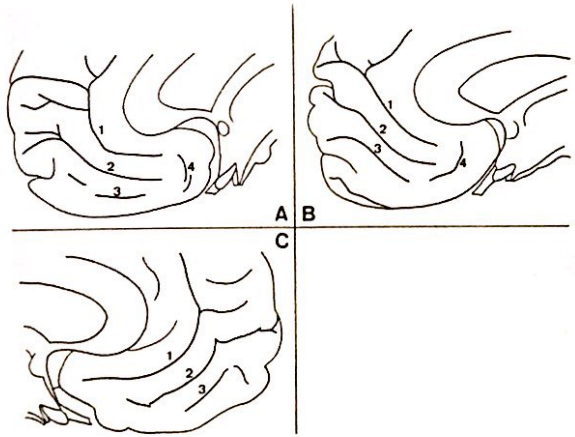
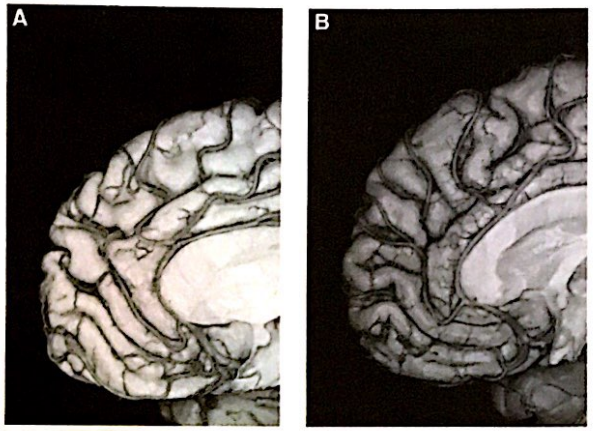


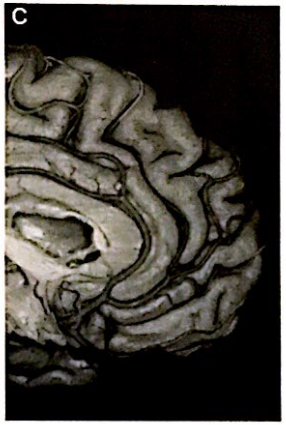
Figure 28.2
Medial surface: frontal lobe

I. Arteries
Anterior cerebral artery

II. Sulci
1. Cingulate sulcus
2. Superior rostral sulcus
3. Inferior rostral sulcus
4. Anterior parolfactory sulcus







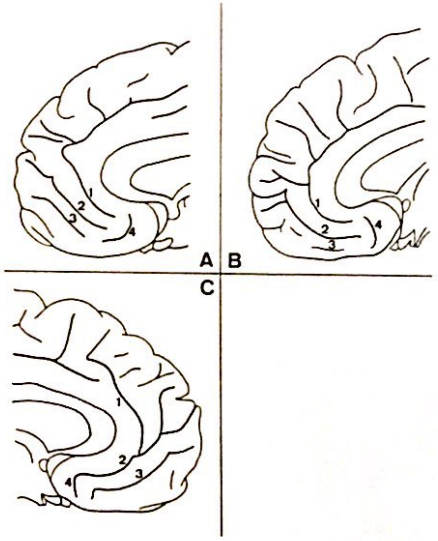


Figure 28.3
Medial surface: frontal lobe

I. Arteries
Anterior cerebral artery

II. Sulci
1. Cingulate sulcus
2. Superior rostral sulcus
3. Inferior rostral sulcus
4. Anterior parolfactory sulcus

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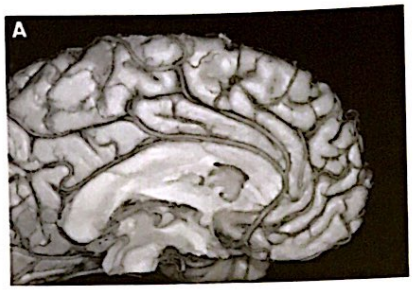
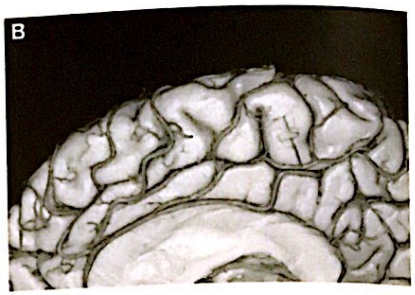




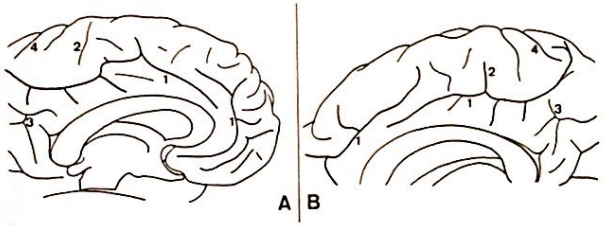


Figure 28.4
Medial surface: frontal lobe

I. Arteries
Anterior cerebral artery

II. Sulci
1. Cingulate sulcus
2. Paracentral sulcus
3. Subparietal sulcus
4. Central sulcus

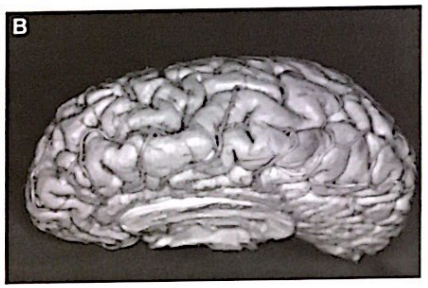


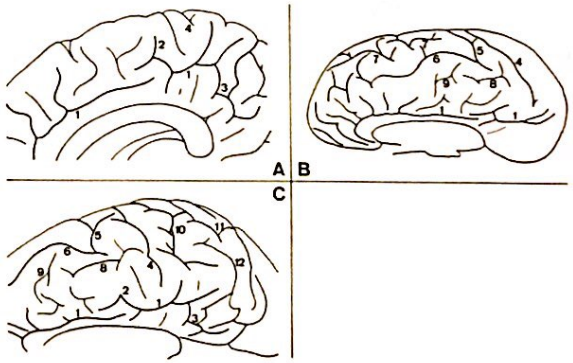
Figure 28.5
Medial surface: superior margin of the hemisphere

I. Arteries (A–C)
Anterior cerebral artery

II. Medial surface sulci (A)
1. Cingulate sulcus
2. Paracentral sulcus
3. Subparietal sulcus
4. Central sulcus

III. Anterior portion of the superior margin (B)
5. Superior precentral sulcus
6. Superior frontal sulcus
7. Intermediate frontal sulcus
8. Marginal precentral sulcus
9. Medial frontal sulcus

IV. Middle portion of the superior margin (C)
10. Postcentral sulcus
11. Intraparietal sulcus
12. Superior parietal sulcus



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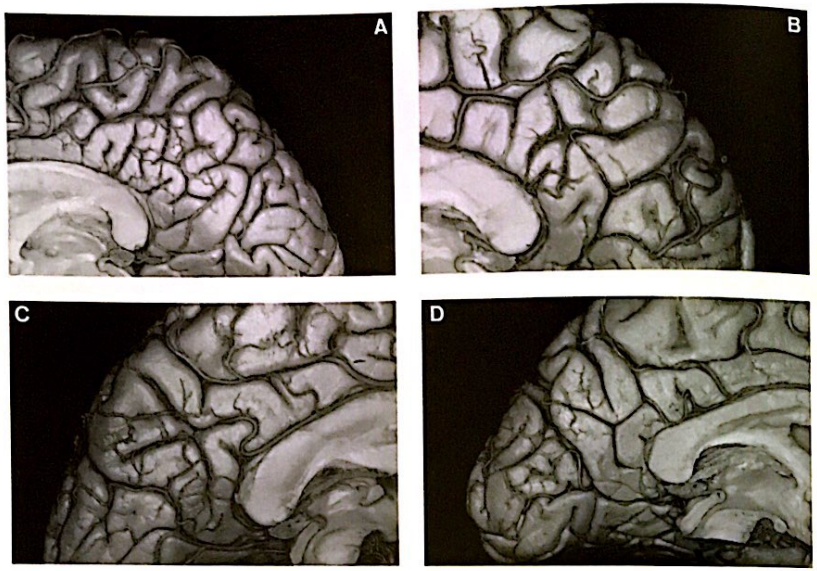


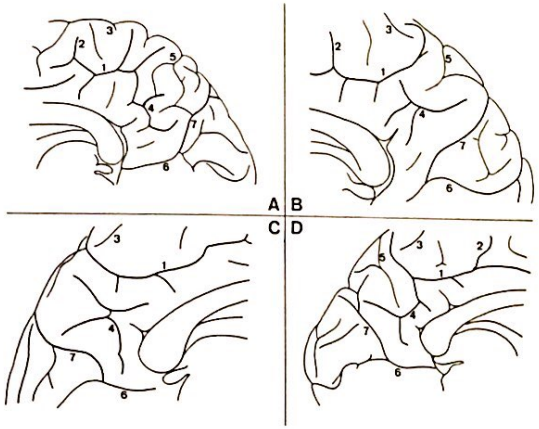


Figure 28.6
Medial surface: precuneus

I. Arteries
Anterior cerebral artery
Posterior cerebral artery

II. Sulci
1. Cingulate sulcus
2. Paracentral sulcus
3. Central sulcus
4. Subparietal sulcus
5. Superior parietal sulcus
6. Calcarine sulcus
7. Parieto-occipital sulcus

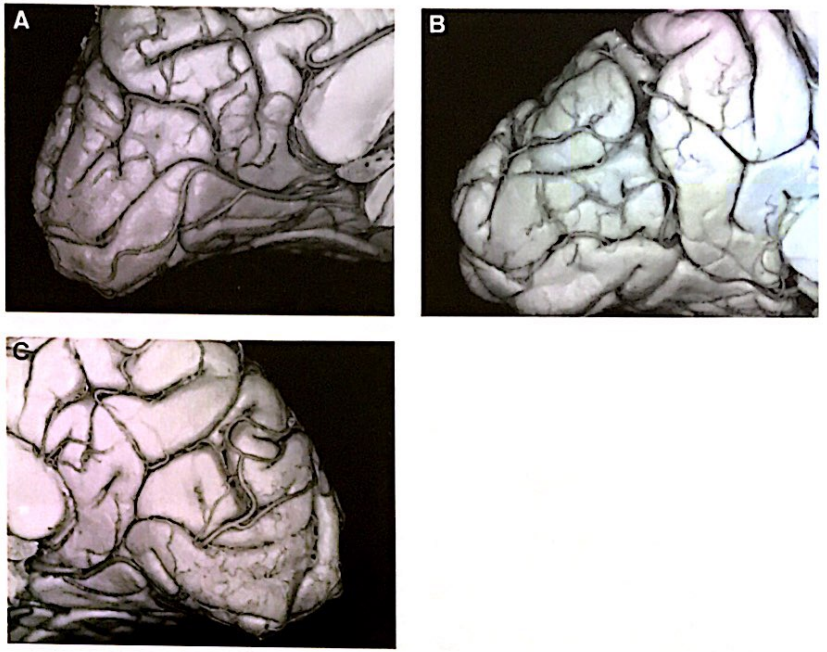
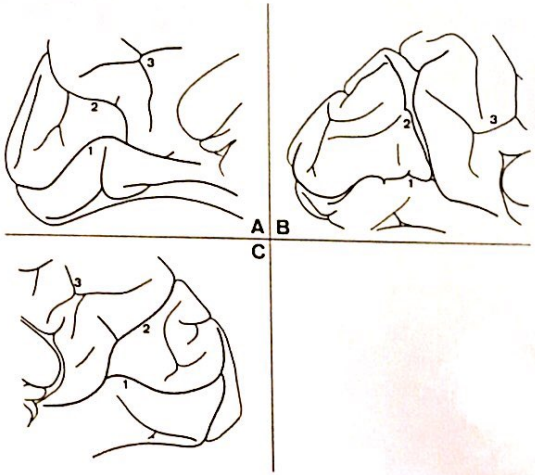


Figure 28.7
Medial surface: occipital lobe

I. Arteries
Posterior cerebral artery

II. Sulci
1. Calcarine sulcus
2. Parieto-occipital sulcus
3. Subparietal sulcus



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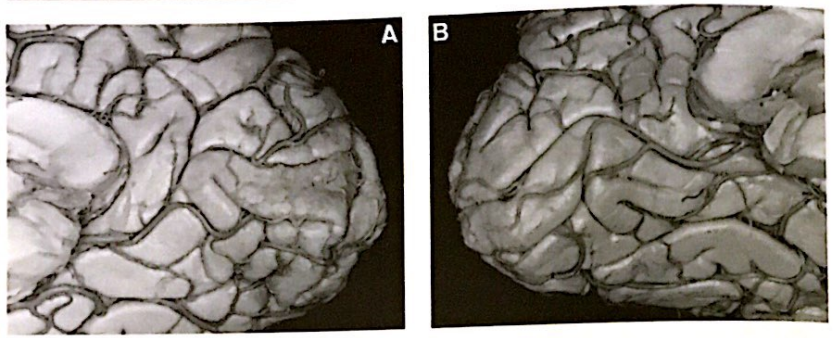


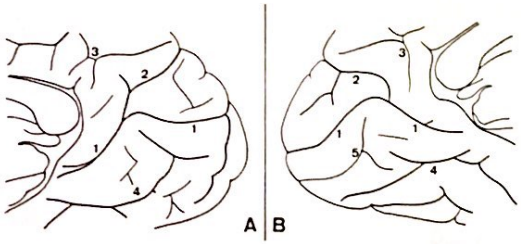


Figure 28.8
Medial surface: occipital lobe

I. Arteries
Posterior cerebral artery

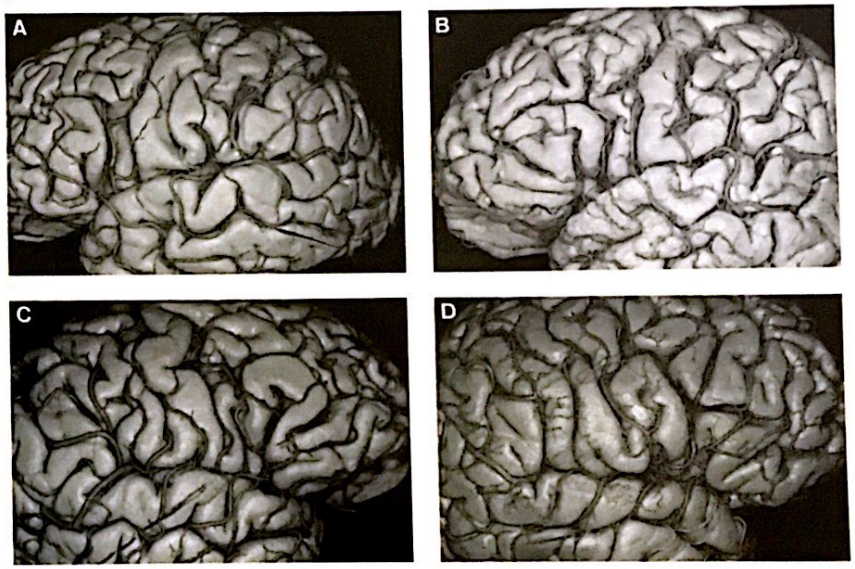
II. Sulci
1. Calcarine sulcus
2. Parieto-occipital sulcus
3. Subparietal sulcus
4. Collateral sulcus
5. Intralingual sulcus

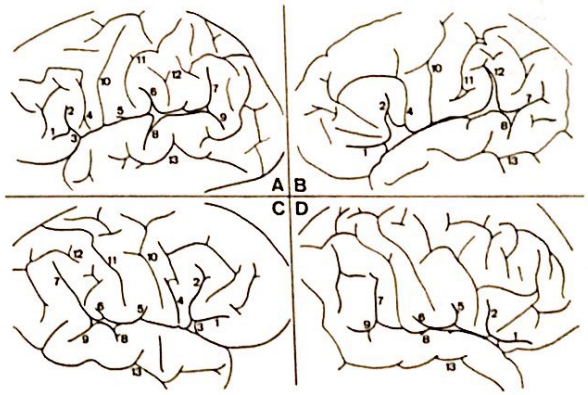
Figure 29.1 ▷
Sylvian fissure

I. Arteries
Middle cerebral artery

II. Sulci
1. Horizontal ramus
2. Ascending ramus
3. Common trunk
4. Diagonal sulcus
5. Anterior subcentral sulcus
6. Posterior subcentral sulcus
7. Terminal ascending segment
8. Transverse temporal sulcus
9. Terminal descending segment
10. Inferior precentral sulcus
11. Central sulcus
12. Postcentral sulcus
13. Superior temporal sulcus

Chapter 29
Sylvian Fissure





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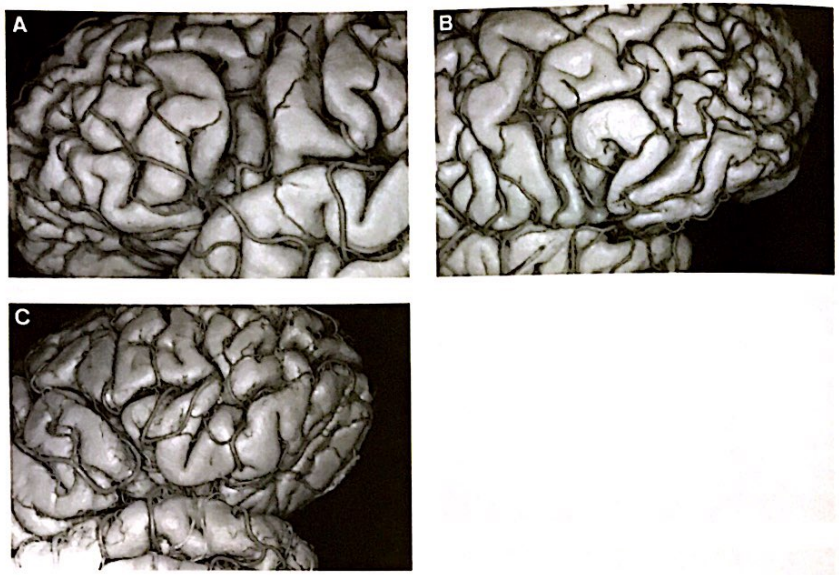


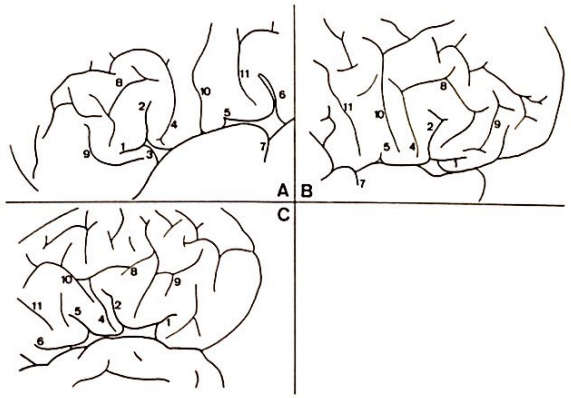


Figure 29.2
Sylvian fissure

I. Arteries
Middle cerebral artery

II. Sulci
1. Horizontal ramus
2. Ascending ramus
3. Common trunk
4. Diagonal sulcus
5. Anterior subcentral sulcus
6. Posterior subcentral sulcus
7. Transverse temporal sulcus
8. Inferior frontal sulcus
9. Fronto-orbital sulcus
10. Inferior precentral sulcus
11. Central sulcus

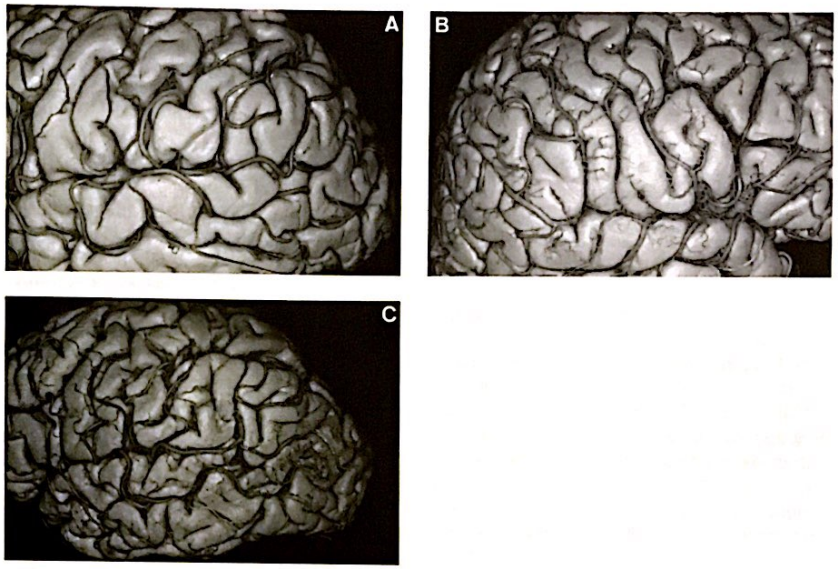
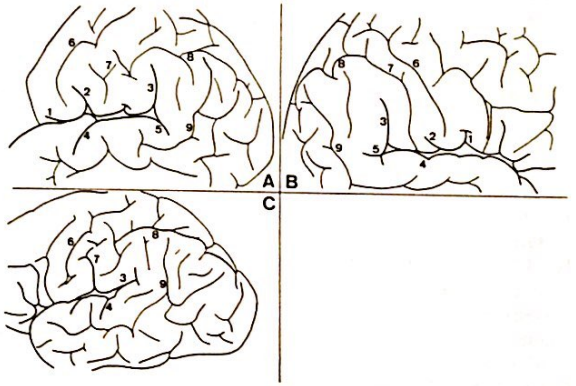


Figure 29.3
Sylvian fissure

I. Arteries
Middle cerebral artery

II. Sulci
1. Anterior subcentral sulcus
2. Posterior subcentral sulcus
3. Terminal ascending segment
4. Transverse temporal sulcus
5. Terminal descending segment
6. Central sulcus
7. Postcentral sulcus
8. Intraparietal sulcus
9. Superior temporal sulcus



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